ELECTRICAL REVIEW

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21st May, 1948

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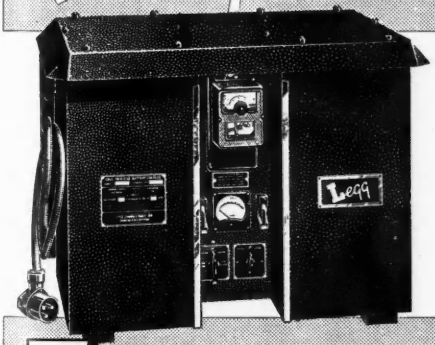

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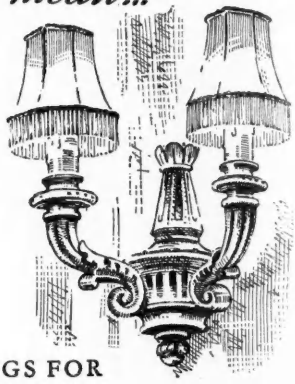

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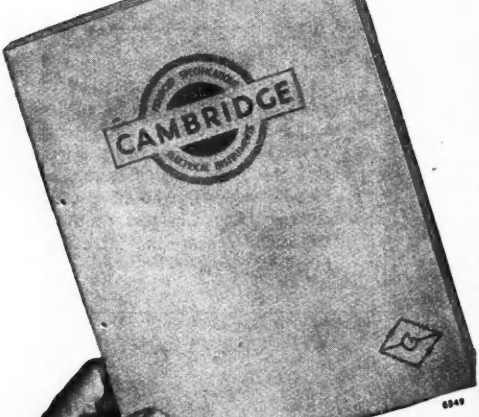

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ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXLII. No. 3678 21st MAY, 1948 9d. WEEKLY

British Water Power

Policy of the North of Scotland Board

RISING costs and scarcity of fuel have heightened public interest in water power in this country. The biggest single source, the Severn Bore, has been estimated to be capable of yielding 800,000 kW (nearly as much as the generating plant deficiency expected in 1951-52) and 2,190 million kWh yearly. In cost of production the scheme would compete with coal at 49s. per ton delivered to power stations in the neighbourhood, which is under the present average price. However, the diversion of material and labour represented by a capital expenditure of the order of £50 million rules out this project at the present time, since capital retrenchment as well as fuel saving is necessary. Further, as the work of construction would take eight years it would contribute nothing to immediate needs.

Capital Charges and Coal Saving

Financial stringency is unfavourable to water-power developments of the usual kind, which are based on the idea of continuous output. These usually cost considerably more per kW installed than do equivalent steam stations, and the question thus becomes one of whether the higher capital charges are less than the value of the coal saved. The basis of this comparison has been considerably modified in the new water-power schemes for Scotland (many of which were well under way before the publication of the White Paper on "Capital Investment in 1948") which are expected to supply 390,000 kW in 1951-52 and 465,000 kW in the following year. Brief particulars of the two most recent schemes, the Glen Garry and Glen Moriston, with a total installed capacity of nearly 100,000 kW, are given in this issue.

The Cooper Committee, whose investigations furnished a basis for the Act of 1943 setting up the North of Scotland Hydro-Electric Board, provisionally assessed the capacity of fresh developments at 450,000 kW, corresponding to an output of about 4,000 million kWh each year at 100 per cent load factor. In its preliminary programme the Board found that 811,000 kW could be provided but with a yearly output of only 2,250 million kWh.

Low Load Factor Operation

The reason for this discrepancy (foreshadowed in the Cooper Report) was that detailed surveys indicated the economies obtainable by designing the stations specifically for operation at relatively low load factors. This might appear to sacrifice coal saving to plant capacity, but in practice, in the absence locally of large-scale electro-chemical or electro-metallurgical processes, it is more than doubtful whether the output at high station load factor could have been absorbed. Developments would have been restricted to certain sites, and less than the 2,250 million kWh would probably have been obtainable.

By being content with mainly peak-load operation the Board seems to have achieved an unusual reconciliation between capital and fuel saving, since much of the heavy investment in storage reservoirs and other civil engineering work is avoided and more flexibility in expansion is permitted

by the ability to add inexpensive generating units as required. This should in many cases make the cost of hydro-electric stations comparable with that of steam stations and, in addition, it eliminates the cost of coal. Under such conditions, there being no stand-by losses, the hydro station should be especially suitable for peak-load working, provided unorthodox use of transmission lines to deal with peak loads at possibly remote centres of consumption does not become excessive. Developments on the lines indicated above would not of course be possible unless the grid provided a ready-made market for the electrical output. Although close economic comparisons between different methods of generation will always be of the first importance, the need for exploiting all sources of power at costs which industry can pay is likely to become more and more apparent.

Nationalization with a Difference

In the resignation of Sir Charles Reid from the National Coal Board many people will see a warning to the British Electricity Authority, whose chairman was once a member of the N.C.B. Sir Charles has flatly said that he has no confidence in the Board or in the organization it has set up—which he describes as "cumbersome and uninspired." He does not believe that it can produce the coal in the quantity and at the price required. We have no fear at present that the B.E.A. is developing on the same lines. Quite the opposite is the case; it is most anxious to have the advice and goodwill of all in the industry and all who have contacts with it, and is shaping its policy accordingly. Of course it was fortunate in taking over an industry which was well and harmoniously run and had secured the confidence of the public, things which could hardly be said of the coal industry.

Colliery Electrification

Although mining conditions in the United States differ materially from those found in this country, it is clear from the Young Report (the electrical bearings of which are summarized in this issue) that developments there repay study. This applies more particularly to methods of bringing coal to the surface and to its preparation. A measure of what the complete electrification of British mines would mean is given in an E.D.A. Report of last year, which shows that about 1·75 million kW of additional generating plant would be required. While opportunities for burning raw fuel of high ash content on anything like the scale found in Pennsylvania are unlikely to present themselves in Great Britain, the implications of this development should be well worth further investigation.

Common Factors

Further statements by chairmen of Electricity Boards on the necessity for immediate increases in charges in some of their districts indicate that there is a common aim although the Boards are ostensibly acting independently. First, all the pronouncements are based on a sort of axiom that a running charge of less than ¾d. per kWh in domestic (and other than non-industrial) two-part tariffs is now uneconomical. It may therefore be expected that eventually this minimum will be generally applied thus closing a chapter which began with the "Point Five" group many years ago. At that, electricity will not be dear in comparison with most other commodities and services, but we may still hope that a lower figure will one day be possible. Secondly, the Boards are following up Lord Citrine's suggestion that 6d. per kWh is enough to charge for lighting and are reducing the flat rates where necessary. Generally, standing charges are to remain unaltered for the present; the decisions of the Yorkshire and Eastern Electricity Boards to raise rateable-value charges seem to be the only exceptions.

Choosing Transformers

How much more difficult the prevailing uncertainties have made the correct choice of transformers was evident in the discussion last week of Mr. B. Calvert's I.E.E. paper on Transformer Economic Efficiency. Complications are the uncertainty of the relationship between the capital charges, which affect the cost of copper losses, and coal prices, which affect the cost of iron losses, and such extraneous factors as the regulation relating to minimum flash density permissible. Nevertheless the effort was well worth making and the technique proposed could be extended to other electrical apparatus.

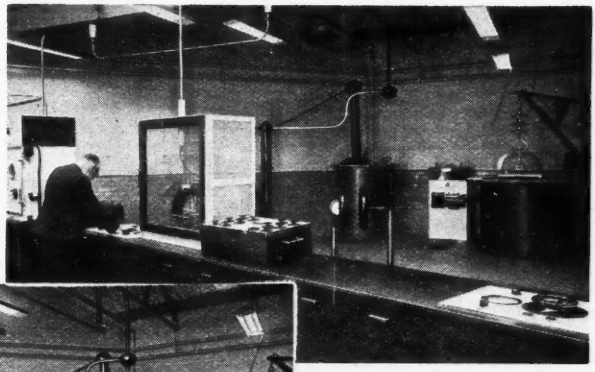
High-Voltage Laboratory

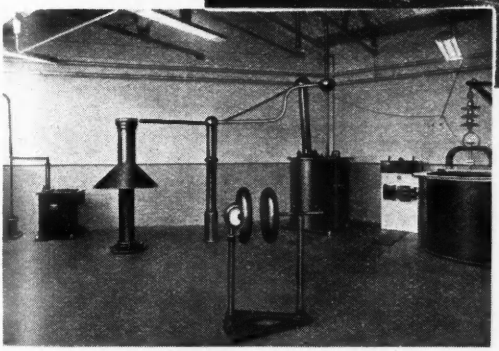
Testing Electrical Sheet Insulation

IN the *Electrical Review* of 9th April we described the processes involved in the production of electrical sheet insulation at the works at St. Helens of Ashdowns, Ltd. To ensure the high quality and the consistency of the products the company has installed at the works a comprehensive high-voltage electrical laboratory which is devoted entirely to the testing of and research work on the products.

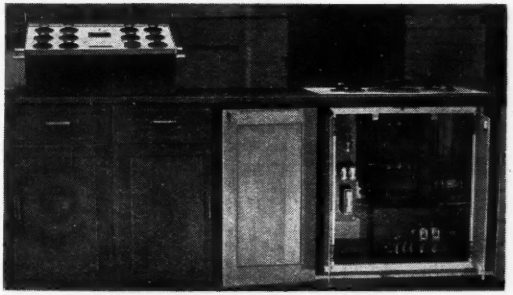
The power factor of finished materials is measured at 50 cycles per second, and 10 per cent is selected for electrical strength tests, both parallel to, and normal to, the laminæ. A further 1 per cent is subjected, in addition to insulation resistance and surface and volume resistivity tests, to a full range of mechanical tests. Checks on the effects of high temperatures and humidities are also carried out periodically. Where customers' applications involve the use of frequencies higher than 50 cycles, additional tests for power factor and permittivity are carried out at 1,000 cycles per second.

The testing equipment was designed and installed by the Metropolitan-Vickers Electrical Co. in conjunction with the company's own engineers and it enables testing to be carried out to all B.S. Specifications and provides sufficient flexibility for a considerable degree of development and investigational work. The main components of the installation in brief are two h.v. supply transformers, complete with an interconnecting overhead distribution system and their control gear; a 50-cycle Schering bridge; a testing cage; three heat- and





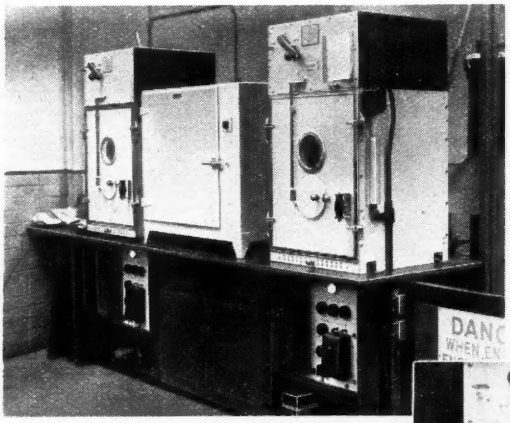
These photographs of the high-voltage area were taken without the screens and interlocked gates

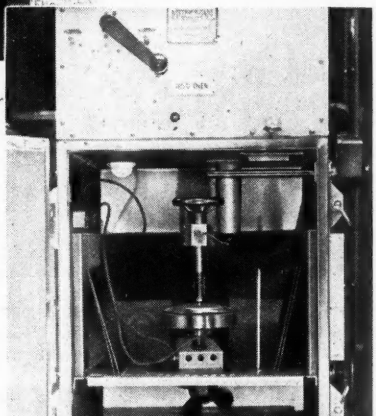


The 50-cycle bridge will work at voltages up to 200 kV; 200-kV control desk

humidity-treatment testing ovens; an electrically heated immersion-testing oil tank; an electrostatic voltmeter; an audio-frequency Schering bridge; an insulation surface and volume resistivity tester; and a 15-ton universal mechanical testing machine.

The laboratory is in two parts, access to the h.v. area being obtained through interlocked gates. Immediately outside this area





Special ovens enable measurements to be carried out under desired conditions of temperature and humidity; (right) dry oven open

are the testing cage and ovens which can be fed from the 30-kV transformer. The layout of the h.v. area can best be depicted by references to the first two illustrations, the photographs for which were taken without the screening and interlocking gates in position.

In the first picture there are seen on the bench in the foreground, left to right, one of the ovens, the 200-kV control panel, the testing cage, the 50-cycle bridge and the 30-kV control panel; in the background are the 200-kV transformer in the corner, and the oil tank and its controls. The second illustration shows the 30-kV transformer, crest voltmeter, condenser and resistance on the extreme left; the air condenser; the resistance and air condenser for the 200-kV transformer; the 200-kV transformer; the oil tank, complete with its electrodes, and its control panel; and, in the centre foreground, the electrostatic voltmeter.

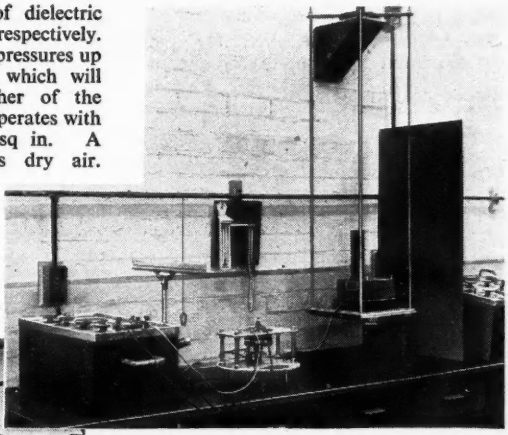
The 200-kV indoor, oil-immersed naturally-cooled transformer has an intermittent rating of 10 kVA; the 30-kV transformer is similar in type, but has a continuous rating of 2 kVA. Both are individually operated from the control bench, and the control panels which are incorporated are of the desk-cubicle type.

"Variac" transformers in the primary circuit afford smooth variation from zero to full voltage. The effective voltage of the secondary circuit is determined by a crest voltmeter which measures the charging current of the respective condensers by means of moving-coil instruments calibrated in kV (crest volts/$\sqrt{2}$). Rectification of the charging circuit is effected by a Chubb & Fortescue circuit employing two diodes. A current-limiting resistance is also incorporated.

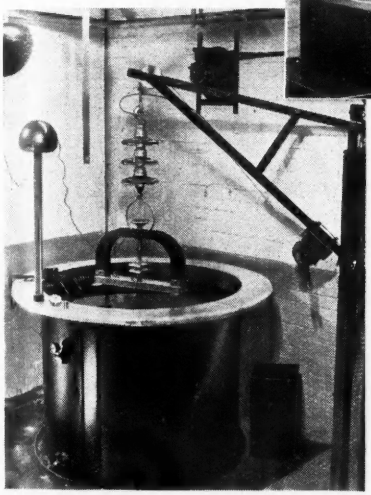
The h.v. supply is distributed by independent overhead bus-bar systems, one insulated for 200 kV and the other for 30 kV. The 200-kV system can be connected to the compressed-air condenser, the oil testing tank or the electrostatic voltmeter, while the 30-kV system, which can also serve any of these components, may also be extended to feed the testing cage and the ovens.

Since wattmeter methods of power factor measurement are not suitable for the precise testing required, there are two Schering

bridges for the measurement of dielectric losses, at 50 c/s and 1,000 c/s respectively. The 50-cycle bridge will work at pressures up to 200 kV and its condenser, which will work in conjunction with either of the transformers, 200 kV or 30 kV, operates with compressed air at 150 lb per sq in. A calcium-chloride intake ensures dry air. The designed capacitance is 16π $\mu\mu$F ($\pm$ 0·1 per cent) at 150 lb per sq in, and its actual measured capacitance is 50·3 $\mu\mu$F at 150 lb per sq in. Its p.f. at 50 cycles is less than 0·00001. The bridge box itself consists of resistance arms R 3 and R 4, a condenser C 4 and a fixed-frequency vibration galvanometer tuned to 50 c/s and with a sensitivity of 18 mm per micro-ampere. R 4 is a non-inductive resistance of $1{,}000/\pi$ ohms; R 3 is a variable non-inductive resistance with a total value of 6111·1 ohms available in steps of 0·01 ohm; C 4 is a variable capacitance, the values of the condensers being chosen so that at 50 c/s the dial readings indicate the product ω C 4 R 3 (tan δ) directly up to a maximum of 1·111 in steps of 0·0001. As a safety precaution in case of flashovers spark gaps are fitted in parallel with R 3 and R 4. By means of a suitable distribution board the bridge can be connected to the humid and dry ovens, the test cage, the oil test tank, or for measurements in air.



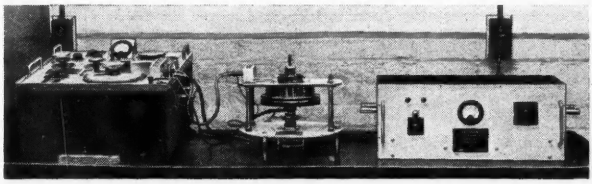
Measurements of surface and volume resistivity are carried out on a set-up employing a very high sensitivity reflecting galvanometer, etc.



All tests for electric strength are carried out under oil in this tank with B.S. electrodes

The equivalent series capacitance of the specimen (in $\mu\mu$F) is given by CX = CS $\times$ R 4/R 3, which equals $16\pi \times 1{,}000/\pi \times$ 1/R 3; *i.e.*, CX = 16,000/R 3 $\mu\mu$F. If the p.f. of the specimen is cos ϕ, then tan δ = tan $(\pi/2\text{-}\phi)$, where δ equals the loss angle of the dielectric and cos ϕ = tan $\delta \times 1/(1 + \tan^2 \delta)^{\frac{1}{2}}$. Thus, when tan δ is small this becomes cos ϕ= tan δ.

The power loss in the specimen is given by $W = \dfrac{E^2 \omega C \times \tan \delta}{1 + \tan^2 \delta}$ watts, where E = applied voltage and $\omega = 2\pi f$, and where



Audio-frequency bridge equipment incorporates a mains-operated oscillator which provides a test voltage at 1,000 cycles per second

tan δ is small this becomes $W = E^2 \omega C \times \tan \delta$ watts.

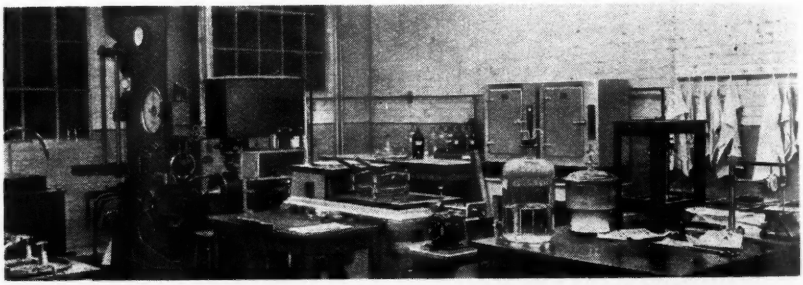
The permittivity of the dielectric is obtained from the formula for the capacitance of a flat-plate condenser, *i.e.*, $C = \frac{KA}{4\pi d}$, e.s.u., *i.e.*, $C = 0{\cdot}0884 \frac{\Sigma A}{d}$, or again $\Sigma = \frac{11{\cdot}3\ Cd}{A}$, where C = capacitance in $\mu\mu$F, Σ = permittivity, A = effective area of the electrodes in sq cm, and d = thickness of the specimen in cm.

As tests are required to be carried out under varying conditions of temperature and humidity, special ovens have been designed and built to enable measurements to be made under the actual conditions desired. The h.v. supply is taken to each of the ovens through an individual isolating switch mounted above and controlled from the front of the oven by a handle. A cam on the shaft of the isolator short-circuits the interlocks on the oven doors when they are in the open position. Should, however, the isolator not be fully opened, either the small or the large door will actuate the interlock switch. Each oven is permanently connected by screened leads to the distribution board of the Schering bridge to allow measurements to be made with minimum difficulty.

The ovens are each about 2 ft cube externally, and each one is fitted with a porcelain roof bushing suitable for 30 kV, and two l.v. porcelain bushings in one side for the bridge and earth connections. Thermostatically-controlled sheathed tubular heaters are fitted in the sides, back and base. An internal circulating fan is also provided to ensure even conditions throughout the oven. Both ovens are similar in construction, but one is arranged to provide dry heat at from 30 to 120 deg C, while the other one will provide humidities of up to 100 per cent at temperatures up to 60 deg C.

All tests for electric strength, both perpendicular and parallel to the laminæ, are carried out under oil at 90 deg C, using the types of electrodes specified in B.S.S. 1137/1943. For this purpose the oil tank already referred to is used. It is 4 ft 6 in. in internal diameter and it is fitted with thermostatically controlled grid heaters giving a temperature range from 50 to 110 deg C. The heaters are controlled from the separate cubicle and they can be connected in star or mesh on the three-phase mains.

The audio-frequency bridge equipment incorporates a mains-operated oscillator which provides a test voltage at 1,000 c/s. The bridge box is direct reading, and it covers the range 20 to 6,000 $\mu\mu$F by means of the scale factors 0·2, 1 and 5 on a standard variable air condenser with a range of 100 to 1,200 $\mu\mu$F. Tan δ values are read directly in the range 0 to 1·111 in steps of 0·001.



All mechanical tests are carried out on a 15-ton universal testing machine

The standard Schering bridge circuit is used, with two capacitance arms, one a standard condenser C 2 and the other the test condenser C 1, and two resistance arms R 3 and R 4. In parallel with R 4 is a variable capacitance C 4 which provides the means of balancing the impurities in the arm C 1.

A Wagner earthing device is incorporated to ensure accuracy and this is balanced alternately with the bridge itself to bring the low-potential electrodes and screens of the condensers to earth potential. A state of balance is reached when $C\,1 = \frac{R\,4}{R\,3} C\,2$ and $\tan \delta = \omega\ R\ 4\ C\ 4$, where $\omega = 2\pi f$, δ = loss angle of condenser C 1, and $R\ 4 = \frac{2{,}500}{\pi} = 795{\cdot}8$ ohms. The Wagner earth has two arms, the X arm being a capacitance

C and a variable resistance RX in parallel with the stray capacitance to earth of the h.v. parts of the bridge, and the Y arm having a variable inductor in series with a variable resistance RY which has a coarse and fine adjustment. The balance detector is a visual instrument proportional to the out-of-balance voltage with a full-scale deflection of 1 mA.

The amplifier is of normal design, except that negative feed-back is employed through a parallel tee network to give critical tuning to the designed frequency. The output current is derived from a valve bridge network which remains balanced until a signal is impressed on the input. The sensitivity at the tuned frequency is 0·03 mA per micro-volt, and this decreases with increase in the input signal to give a saturation value of 0·85 mA. The formulæ employed for the determination of p.f. and permittivity are identical with those employed for the 50-cycle bridge.

The measurements of surface and volume resistivity are carried out on a set-up employing a very high sensitivity reflecting galvanometer, special electrodes for the specimen, and a special resistance box. The method consists of measuring the current passed through the specimen when a known direct-current voltage is employed. The galvanometer has a sensitivity of 14,000 mm per micro-ampere at one metre scale distance. The calibration of the galvanometer is provided for by a circuit in which a current of 1 mA is supplied by a Weston standard cell and an accurate series resistance. All the switches and leads are appropriately guarded, so that unwanted leakage currents do not pass through the galvanometer.

The test voltage is provided by a rectification of the 230-V 50-cycle mains supply, employing Westinghouse rectifiers in a voltage-doubling circuit and "Stabilovolt" tubes to give a maximum of 500 V free from fluctuations. Volume resistivity is calculated from the formula $Pv = \frac{\pi}{4} \times \frac{d^2}{t} \times Rv$, the calculation assuming only a small annular gap between the central electrode and the guard ring. For the electrodes actually employed d = 5·0 cm; therefore $Pv = 19{\cdot}6 \times \frac{1}{t} \times Rv$, where Pv = volume resistivity in ohms per cm³, Rv = volume resistance in ohms, d = diameter of central electrode in cm, and t = thickness of specimen in cm.

Surface resistivity is calculated from the formula $Ps = \frac{1}{2\pi \times \log_e \frac{D}{d} \times Rs}$, where Ps = surface resistivity in ohms per cm², Rs = surface resistance in ohms, D = internal diameter of the outer ring in cm, and d = diameter of the central electrode in cm. For the electrodes actually employed D = 7 cm and d = 5 cm; therefore Ps = 18·7 × Rs.

All mechanical tests are carried out on a Denison universal testing machine of 15 tons capacity, with the four ranges: 0 to 3,360 lb in 5-lb divisions; 0 to 6,720 lb in 10-lb divisions; 0 to 16,800 lb in 25-lb divisions; and 0 to 33,600 lb in 50-lb divisions. Load is applied hydraulically, one end of the specimen being acted upon by the hydraulic straining system, while the other end is connected to the weighing system. The hydraulic straining gear is oil fed from a high-speed multi-piston variable displacement pump driven by a 1-h.p. motor.

The straining speed can be varied by infinitesimal increments and decrements between the values of 0 and 15 in. per minute, and the operation is free from pulsation. The tests carried out on this machine include tensile strength, Young's modulus, sheer strength, modulus of rupture, compression strength and Brinell hardness. All the tests are undertaken in accordance with the relevant specifications.

We are indebted to Ashdowns, Ltd., for permission to visit the laboratory and to publish this article, and to Mr. E. R. Spurgeon, technical manager, for help in preparing the article.

Technical Education

THE Institute of Economic Engineering has revised its syllabuses and examinations as a result of the Urwick Committee's recommendations on "Training for Management." The six specialist subjects selected to comprise the technical content, as distinct from the management content, of their examinations are:—Pre-production planning; production planning and control; methods, motion and time study; determination of manufacturing cost standards; performance and cost control; and production incentives. The common management subjects recommended in the Urwick Report were accepted as being suitable to meet the educational requirements on the managerial side of the Institute examinations. Full information will be circulated shortly by the Institute in the form of a brochure.

Views on the News

Reflections on Current Topics

PRINCIPAL impressions gained at the Electrical Trades Union Conference at Great Yarmouth last week were the firmness, tempered with humour, with which the president (Mr. Frank Foulkes) handled the meetings and the high standard of the contributions to the debates. Delegates' speeches were pointed and vigorous although occasionally rather acid—particularly when referring to relations with other trade unions.

* * *

Mr. Gaitskell was unable to fulfil his engagement to address the conference, presumably on account of the prolongation of the committee stage of the Gas Bill. This Bill is even less liked by the Opposition than the Electricity Bill and each clause has been painfully passed. Proceedings on the Bill were allowed to run on in spite of the approach of Whitsun; I suppose the Government thought short-circuiting inappropriate in this case.

* * *

According to the New York *Electrical World*, which has made a close study of the subject, the United States is in no hurry to apply atomic energy to other than military purposes. It has ample reserves of coal (put at 2,000 years' supply) and water power and atomic energy would be very little cheaper than that derived from coal and not so cheap as hydro-electric production. The *Electrical World* thinks that development will be faster in "coal-starved" Britain and in the Balkans and Western Russia where fuel scarcity and transport difficulties would make atomic power attractive.

* * *

When the British Electricity Authority circulated its folder bearing the picture of a child on a chair operating a wall switch ("Mummy forgot to switch it off!") I rather resented the implication that switching off electricity was of greater importance than its use. Other critics have arisen since the picture appeared in a much larger size on hoardings all over the country. One, writing to *The Times*, thinks that the poster "is calculated to undo many patient lessons designed to discourage children from fiddling with electric gadgets, climbing over furniture, and incurring needless risks." The *Evening News*, pointing out that the switch is already in the "off" position, says that when the little boy has switched off he has to climb down from his precarious position in the dark. This paper also says that a question is to be asked about it in the House of Commons. Perhaps the B.E.A. had better think up a more acceptable idea.

* * *

The very excellent weather we have experienced over the Whitsun holiday enabled countless people to enjoy a few days' relaxation in the countryside. One camper, however, does not consider the simplicity of this form of life very attractive. He suggests that it would be a good idea if an electricity supply through slot-meters could be provided to country camping sites. This would, he says, enable the camper to have a hot drink without the trouble of making a fire and would prevent danger from open fires. I can visualize the ultra-modern camper arriving with a multi-flex adaptor to plug in his hot-plate, reading lamp, alarm clock and electric razor. Perhaps it wouldn't be quite so safe after all.

* * *

While the South Eastern Electricity Board was able to steal a horse, in the shape of a large building at Hove which was formerly the Prince's Hotel, the South-East Scotland Board is not allowed to look over the hedge—in other words to acquire a private hotel in Edinburgh for use as offices. The Edinburgh Housing Committee has rejected the proposal by a narrow majority and the matter is to be further considered by the Town Council.

* * *

The ordinary cooker control unit is a quite substantial piece of switchgear; it is rated at round about 30 A at the normal voltage. Yet if the cooker switches are properly used it is called upon to make and break only the few milliamps represented by the pilot lamp. With properly trained users, who could be relied upon never to use the main switch to cut off all the oven elements and hot-plates at once, a simple two-pole tumbler switch would seem to be adequate. But because of human fallibility hundreds of tons of iron and copper are diverted to this wasteful use and there is no remedy so far as I can see.—**REFLECTOR.**

Mixed Installations

Problems of the Factory Engineer

By F. G. Marshall, A.M.I.E.E.

As a result of the present critical shortage of electrical equipment and accessories of all kinds, factory engineers are forced, much against their will, to accept installations of a very mixed nature. This gradual departure from a policy of standardization is very regrettable in a number of ways, especially so in the case of large works that have adopted extensive standardization over many years.

As a consequence we find, for example, lighting layouts and extensions installed in conduit of one manufacture with accessories and fittings of another. This in itself in no way detracts from the efficiency of the completed layout, as, in the vast majority of cases, manufacturers work to definite standards, and their products are therefore interchangeable, but sooner or later further deviations take place which are far more harmful. This may initially occur in a number of ways, as, for instance, when during the erection of a galvanized-conduit installation, a shortage of bends or inspection elbows occurs. In order to complete an installation that is required immediately an engineer may, as a purely temporary measure, use ordinary black enamelled bends, elbows or other conduit fittings, intending to replace non-standard sections by galvanized parts as soon as these are received. The delay may, however, be prolonged and the parts when they do arrive may be required for another section of the factory, with the result that the non-standard "temporary" equipment is forgotten and so becomes part of the permanent installation.

Fuse-Switch Entries

In many districts fuse-switches can be obtained for ordinary open-wire entry, but not for conduit entry, with the result that at the switch position the conduit has to be terminated short of the switch unit, with the addition of a bonding earth wire to ensure the continuity of the system. This is unavoidable at times, but a special record should be kept so that this departure from the usual standards can be soon rectified.

Where a supply of electricity has to be brought underground for a short distance, as for instance between two buildings separated by a road, a frequent practice is to install the cable in heavy-gauge gas pipe instead of in conduit, thereby increasing the life of the installation. If the right type of gas pipe cannot be obtained and conduit has to be used, this case of departure from the factory's standards should also be carefully recorded.

The same consideration applies to numerous instances apart from runs of conduit. Additional lighting fittings and reflectors have often to be installed of a different type and design from those already in use in the factory, or, at times, even in the same room. This often destroys the neat and efficient appearance of the layout, but at times, to avoid holding up production, it is unavoidable.

Oversized Cables

If the factory engineer cannot procure the exact type of medium-voltage cable he requires, rather than hold up the work he will accept and install whatever he can obtain that will efficiently do the job, even if the cable available has a current-carrying capacity considerably in excess of requirements or is a three-core cable when only two cores are needed. In such cases, however, the non-standard cable can usually be regarded as permanent, as it neither reduces operating efficiency nor looks unsightly.

In numerous other ways there is a forced divergence from previously accepted standards. Lighting switches, plugs and sockets, heating elements and a host of other appliances and accessories, have to be installed of types which in earlier days would have been entirely unacceptable.

Electric motors of higher horse-powers than those actually required often have to be accepted in order to bring into commission new equipment at an early date, thereby reducing both the overall efficiency and the power factor of the plant. This is unavoidable at present, though steps should be taken to rectify the position as soon as the market once again approaches the normal.

The present unfortunate position holds one small compensation in that it enables the factory engineer to increase widely his field of knowledge and to gain experience of other makes and designs of machinery and equipment which in normal times would not come his way.

Symmetrical Components

Interpretation of the 'a' Operator

By Professor G. H. Rawcliffe, M.A., D.Sc., M.I.E.E.

IN the *Electrical Review* of 11th October, 1946,* a rule was given by an earlier author for determining the positive-sequence component of current in an unbalanced three-phase system, for the common case where the three line currents have zero sum. (This is, of course, true for any three-phase three-wire system.) It was stated that "$1/\sqrt{3}$ times the resultant of one of the unbalanced vectors (I_x) retarded 60 deg and added to its successor (I_y) gives a positive-sequence component in magnitude, but 30 deg retarded in direction."

This rule should have read "$1/\sqrt{3}$ times the resultant of one of the unbalanced vectors (I_x), added to its successor (I_y) advanced by 60 deg, gives the positive-sequence component of I_x in magnitude, but 30 deg retarded in direction." The same author's rule for the negative-sequence component was:—"Advance a vector (I_x) 60 deg and add it to its successor (I_y). The resultant will be $\sqrt{3}$ times the negative component, but 30 deg retarded in phase." This should have been "Add to a vector (I_x) its successor (I_y) retarded by 60 deg. The resultant will be $\sqrt{3}$ times the negative sequence component of I_x but 30 deg advanced in phase."

The following semi-graphical method, properly applied, leads to correct results. Consider Fig. 1 which was published as part of Fig. 2 in the earlier article mentioned.

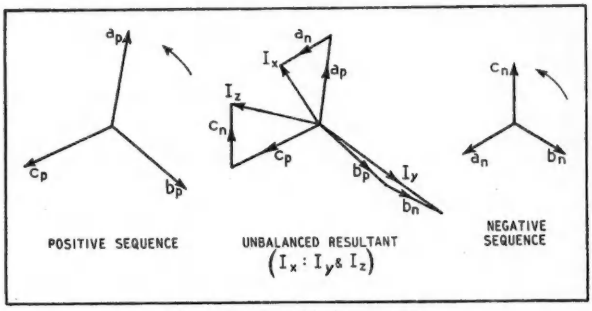


Fig. 1.—Semi-graphical treatment

If I_y, and its components b_p and b_n, are advanced 60 deg, a_n and b_n shifted will cancel, and a_p and b_p shifted will give a resultant $\sqrt{3}$ times either, since they will be at 60 deg to one another. The phase of this resultant will be 30 deg behind a_p.

Similarly, if I_y and its components are retarded 60 deg a_p and b_p shifted will cancel, and a_n and b_n shifted will give a resultant $\sqrt{3}$ times either. The phase of this resultant will be 30 deg ahead of a_n.

In the course of checking the semi-graphical method the present writer was led to draw up the accompanying convenient table of operators. The value of this table is illustrated by proving the correct form of the rules given above. The use of the "j" operator is now common enough; and it is instructive to express the less familiar "a" operator in terms of the "j" operator.

The operator "j" is such that when any vector quantity is multiplied by "j" it is turned counter-clockwise through 90 deg. To multiply by "j" is an instruction: "rotate 90 deg counter-clockwise." The operator "a" is similar, except that the angle of rotation is 120 deg counter-clockwise. Any power of "j" or "a" must be interpreted consistently with these definitions. For example, if the operator "j" is applied four times, the vector is unchanged, and the total rotation is the same as if the "a" operator were applied three times. Therefore $j^4 = a^3 = 1$. Or, again, the operator $a^{1/4}$ means "rotate 30 deg," since this operator applied four times produces 120 deg rotation.

We can therefore draw up a table of equivalent operators for the twelve equally spaced vector positions shown in Fig. 2. The columns containing fractional powers of "j" and "a" follow at once from the definitions of these operators. The equivalent

* "Symmetrical Components—A Graphical Introduction" by B. J. Prigmore, *Electrical Review*, 11th October, 1946, p. 567.

operators, from which fractional indices have been eliminated, may be deduced either by algebra or by consideration of the actual positions of the vectors. For example, as will be seen from Fig. 2, vector 2 may be derived from vector 1 by adding vector 3 to it, and dividing the sum by $\sqrt{3}$. Operationally, this is expressed as the factor $[(1 - a^2)/\sqrt{3}]$. (Vector 3 = $(-a^2)$ × Vector 1). Alternatively, $[(1 - a^2)/\sqrt{3}]^4 = a$, by simple multiplication, using the identity $(a^2 + a + 1) = 0$. [$a^3 = 1$, and thus $(a^2 + a + 1) = 0$.]

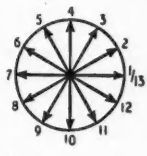


Fig. 2.—Vector positions in table below

All the other equivalent operators may be similarly deduced and the table of results is then available for repeated use.

As is shown by reference to any standard textbook on symmetrical components, if I_x, I_y and I_z are unbalanced three-phase vectors the positive-sequence components in the three phases are given respectively by I_p; $a^2 I_p$; and aI_p, where $I_p =$

$$\left[\frac{I_x + aI_y + a^2 I_z}{3}\right]$$

The negative sequence components are given by I_n; aI_n; and $a^2 I_n$, where

$$I_n = \left[\frac{I_x + a^2 I_y + aI_z}{3}\right]$$

In the special case of a three-phase system with no neutral, $(I_x + I_y + I_z) = 0$, and I_p and I_n may be re-written as

$$I_p = \left[\frac{I_x - a^2 I_y}{\sqrt{3}}\right]\left[\frac{1 - a^2}{\sqrt{3}}\right] \text{ and}$$

$$I_n = \left[\frac{I_x - aI_y}{\sqrt{3}}\right]\left[\frac{1 - a}{\sqrt{3}}\right]$$

Both these relations can be interpreted in words, using the table of equivalent operators reproduced. The operator $[(1 - a^2)/\sqrt{3}]$ is equivalent to a rotation of 30 deg counter-clockwise: $(-a^2)$ to a rotation of 60 deg counter-clockwise. The equation for I_p therefore means:—"Add to one unbalanced vector (I_x) the succeeding vector (I_y) advanced 60 deg: divide the resultant by $\sqrt{3}$ and advance it in phase by 30 deg. This will give the vector I_p."

Similarly, I_n can be interpreted in words, since the operator $\left[\frac{1 - a}{\sqrt{3}}\right]$ is equivalent to 330 deg counter-clockwise (= 30 deg clockwise), and the operator $(-a)$ is equivalent to 300 deg counter-clockwise (= 60 deg clockwise). Unless, however, the values in the table below had already been computed the meaning of the expressions for I_p and I_n would not have been at all obvious.

A well-known form of symmetrical component meter is illustrated in Fig. 3. This meter is, in effect, a means of casting the rules given above into practical form. Currents proportional to the unbalanced voltages to be measured are displaced in relative phase by 60 deg and added together. (λ in the figure is a constant.) If Z_1 is an

TABLE OF OPERATORS

Position No.	Advance counter-clockwise	"j" operator	Equivalent "j" function	"a" operator	Equivalent "a" function
1	0°	j^0	1	a^0	1
2	30°	$j^{1/3}$	$\left[\frac{+\sqrt{3}+j}{2}\right]$	$a^{1/4}$	$\left[\frac{1-a^2}{\sqrt{3}}\right]$
3	60°	$j^{2/3}$	$\left[\frac{+1+j\sqrt{3}}{2}\right]$	$a^{1/2}$	$(1+a) = -a^2$
4	90°	j	$+j$	$a^{3/4}$	$\left[\frac{a\,(1-a)}{\sqrt{3}}\right]$
5	120°	$j^{4/3}$	$\left[\frac{-1+j\sqrt{3}}{2}\right]$	a	a
6	150°	$j^{5/3}$	$\left[\frac{-\sqrt{3}+j}{2}\right]$	$a^{5/4}$	$\left[\frac{a-1}{\sqrt{3}}\right]$
7	180°	j^2	-1	$a^{3/2}$	-1
8	210°	$j^{7/3}$	$\left[\frac{-\sqrt{3}-j}{2}\right]$	$a^{7/4}$	$\left[\frac{a^2-1}{\sqrt{3}}\right]$
9	240°	$j^{8/3}$	$\left[\frac{-1-j\sqrt{3}}{2}\right]$	a^2	a^2
10	270°	j^3	$-j$	$a^{9/4}$	$\left[\frac{a\,(a-1)}{\sqrt{3}}\right]$
11	300°	$j^{10/3}$	$\left[\frac{+1-j\sqrt{3}}{2}\right]$	$a^{5/2}$	$(1+a^2) = -a$
12	330°	$j^{11/3}$	$\left[\frac{+\sqrt{3}-j}{2}\right]$	$a^{11/4}$	$\left[\frac{1-a}{\sqrt{3}}\right]$
13/1	360°	j^4	1	a^3	1

inductive resistance of 60 deg phase angle, and Z_2 is a pure resistance of equal ohmic value, then the reading of I is proportional to a positive sequence component of voltage. If Z_1 and Z_2 are interchanged, the reading of I is proportional to a negative sequence component of voltage. The meter can be calibrated to read these voltages directly.

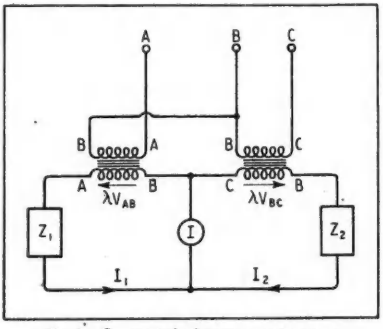


Fig. 3.—Symmetrical component meter

It is impossible to discuss this meter fully here. It may, however, be added that the positive and negative components thus determined do not correspond, and are therefore not in their correct relative phase, but are relatively displaced by 120 deg. The meter is mentioned, however, as exemplifying in practice the matters which have been discussed above.

Aerodrome Communications Equipment

IN anticipation of legislation concerning communication facilities in civil aircraft, E. K. Cole, Ltd., has developed a complete twin channel ground and air installation which meets the recommendations of the International Civil Aviation Organization now in course of implementation by the Ministry of Civil Aviation.

The installation of the first example of this particular make has recently been completed at the Southend municipal aerodrome. It has been found there that if an aircraft is within 60 miles at 4,000 ft contact can always be made with the aerodrome. If necessary the pilot can also be given a course which will enable him to return to base.

The aircraft equipment is a self-contained light-weight transmitter receiver designed to operate at 12 V, d.c. At the aerodrome is a rack-mounted unit comprising two crystal-controlled VHF transmitters and receivers, a control panel and two power units. Provision is made for transmitting and receiving on two crystal-controlled frequencies, one of which would normally be set to the "Universal Guard" frequency of 118·1 Mc/s, while the other would be at the frequency allotted to the local aerodrome and within the 118-128 Mc/s band.

The company has also developed, for use in coniunction with this equipment, a complete direction finding installation which can be automatically tuned to the frequencies of the main transmitters and receivers.

South African News

(From Our Capetown Correspondent)

IT is considered that the new Vierfontein power station will play a big part in opening up the Northern Orange Free State, the Western Transvaal, and North West Cape. The exact output of the station has apparently not yet been decided upon, but it will probably eventually be in the region of 200,000 kW It is expected that this will assist the Northern Free State to become an extensive gold mining and industrial area within a comparatively short time. The Witwatersrand is gradually being built up to the limit of its industrial capacity ; the provision of adequate electricity supplies will go a long way towards inducing the establishment of industry along the western line of the Vaal River. Overseas experience also suggests that cheap electricity can revolutionize farming activities and the development of the small towns within reach of the new station will ultimately also be effected. In the meantime the Commission is carrying electricity supplies into the Northern Free State from the Vaal generating station.

Meter Testing

The Bureau of Standards states that at this early stage in the introduction of a long-term programme of regular meter testing on a Union-wide scale, it is not possible to specify precisely the details of the organization and administration of the services required by the code. Provisionally, however, it may be stated that Class A stations will be required at some seven points in the Union, probably at Johannesburg, Pretoria, Cape Town, Durban, Port Elizabeth, Bloemfontein and in South West Africa. Neither is it possible to state with accuracy the additional equipment and staff which will be required by undertakings for the general application of the code, which requires one-sixth of meters installed to be tested annually.

Conference on Liquid Fuels

THE Institute of Petroleum and the Institute of Fuel are holding a joint conference on "Modern Applications of Liquid Fuels" at Birmingham University from 21st to 23rd September. Among the subjects to be discussed are fuel oil in the steel and metal industries, gas turbines, and diesel engines for power generation and railway traction.

Electricity Charges

Further Statements by Board Chairmen

DURING the past week other chairmen of Electricity Boards have explained at press conferences the circumstances necessitating increases in electricity charges.

Mr. H. J. Randall (**London Board**) referred to Lord Citrine's general statement (reported in last week's issue) and said that the average price of coal had risen by 153 per cent since 1939 and wages by about 78 per cent. The majority of the London undertakings had made no increase in their charges during the past few years and many of them were working at a loss when the Board took over. Twenty-two undertakings out of forty were incurring deficits totalling £900,000 a year.

The Board aimed at ensuring that consumers paid a fair and economic price so that it should not operate at a heavy loss for which it was in no way responsible. Ultimately it was hoped to introduce uniform tariffs throughout London but this could not be done for some time. The increases now to be made would help to achieve a great measure of uniformity. A lower rate than ¾d. per kWh for the secondary charge of a two-part tariff was now uneconomical. It was therefore proposed that this should be the minimum figure in nearly all districts. Certain other tariffs would be increased to bring them up to an economic level. Immediate price increases were to be made in Battersea, Barking, Barnes, Beckenham, Bethnal Green, Erith, Fulham, Hackney, Hammersmith, Hampstead, Ilford, Leyton, St. Marylebone, St. Pancras, Shoreditch, Southwark, Walthamstow, Willesden and Wimbledon.

Mr. Randall gave examples of the way in which the increases would operate in various districts; he said that they would take effect after the meter readings following the publication of the necessary notices.

They expected to recoup about £700,000 of the estimated loss by this means; the balance of £200,000 would be made good mainly by economies which the Board hoped to make by its operation.

£1,000,000 Deficit

At his press conference on 11th May, Mr. George Gibson, C.H. (**North Western Electricity Board**) said that the estimated deficit of undertakings in his area was £1,000,000. It was hoped to reduce this by between £500,000 and £600,000 by means of tariff adjustments.

Generally, where the running charge of domestic two-part tariffs was less than ¾d. per kWh it would be raised to that figure. This might also affect other non-industrial consumers and in all cases discounts would be discontinued, but so would meter rents. In rural areas where there had been a surcharge on the "unit" price this would be discontinued when the price was raised to ¾d. per kWh. The maximum flat-rate charge for lighting would be 6d. per kWh, or 6½d. through prepayment meter; this would affect 14 out of the 76 former undertakings.

Mr. Gibson claimed that even greater increases would have been necessary if there had been no co-ordination of the industry. It was not expected that the addition to the average consumer's bill would be more than 9d. a week; it would probably be 6d. a week in Manchester.

Three-farthings Minimum Running Charge

At the **Yorkshire Electricity Board** meeting the chairman, Col. W. M. Lapper, said that the estimated deficit in his area, if existing charges remained unaltered, was £900,000. Six large undertakings in the area, Bradford, Leeds, Huddersfield, Sheffield, Doncaster and Hull all anticipated deficits in the year ending 31st March next year.

To counteract this it was proposed to institute a minimum running charge of ¾d. per kWh in domestic and commercial two-part tariffs; prices below this would be raised. Also the percentage applied to the rateable value for the standing charge of the domestic two-part tariff would be raised to 15 per cent; this would also be the minimum for shops and commercial premises. Standing charges based on number of rooms or size of house would not be altered at present.

It was proposed that all lighting flat rates should be reduced to 6d. per kWh where they were at present above that figure.

According to the chairman, Mr. C. T. Melling, a total loss of £1,500,000 was expected in the current year by the undertakings included in the area of the **Eastern Electricity Board.**

The Board did not propose to try to recover the whole of this amount; it aimed at making economies in various directions and for the time being would be carrying a trading loss. It had been decided to increase charges only where a serious loss had been anticipated by the former undertakers.

Mr. Melling gave details of the proposed increases. He said that in all parts of the Northmet area there would be increases in the fixed charge and the unit charge would be raised to ¾d. Small adjustments would be made in the Hitchin tariff. In the Watford, Bedford, Great Yarmouth, Norwich and Peterborough areas, increases had already been decided upon and would be put into operation, in some cases with slight modifications. In the Luton area the running charge would now be ¾d. per kWh in the urban areas and 0·8d. in the rural districts.

A very slight increase would be made in the

Southend two-part tariff unit charge and in the first block of units on the domestic rate. In Aylesbury only the fixed charges would be increased but there and in several other districts discounts would be discontinued.

No increases would be made in large areas of Norfolk, Suffolk, Essex, Cambridgeshire and Huntingdonshire; although losses were anticipated they would not be of large proportions and the Board would carry them for the time being.

Mr. Melling said that it was estimated that the increased charges would bring in an extra revenue of £1,300,000. The Northmet Company had an estimated loss of £780,000 in the current year. New premises for the No. 4 "Fens" sub-area, including 33 acres of land, would cost £9,000 and the annual charges would be little more than those of the Hobson Street premises of the Cambridge Company.

Mr. L. Howles (**South Wales Board**) stated on 8th May that his Board had been considering the estimated financial position in its area, to ascertain whether any interim steps were necessary with regard to tariff modifications prior to the general consideration that would be given to the simplification and standardization of forms of tariff. It did not propose any increases in domestic tariffs at present.

The **South-East Scotland Board** has also decided that it is unnecessary for it to take any immediate action in the adjustment of domestic and other non-industrial electricity tariffs in its area.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Electricity in the Navy

I WAS extremely interested to read Commander C. F. Nock's explanation of the term "Double L" sweep, given in your issue of 7th May. Another explanation I have received is that the term was derived from the shape of the effective currents' path astern of pairs of "Double L" minesweepers.

With regard to the version in my article, being in some doubt as to the correct origin, I consulted an Admiralty Department before writing this and was given the explanation quoted.

Although as an ex-electrical officer I have little hesitation in accepting Commander Nock's explanation, there would appear to be several schools of thought on the subject, and I should be interested to learn if any technical literature has been previously published dealing with "Double L" minesweeping in which this could be confirmed.

Enfield. R. C. GORDON.

Car Electrical Equipment

I SHOULD be grateful for the advice of your readers on the following problems in connection with lead-acid car batteries:—

One or two cells of a group when fully charged have an acid density approximately 0·020 less than the others. When tested with a drop-tester, etc., the batteries appear to be sound and they work quite well. How can the hydrometer reading be made level with that of the other cells ? What explains this drop in reading, since all cells showed equal values when the battery was new ?

Is it right to undercut the segments of an auto starter armature of any type as one would an auto dynamo armature ?

What is the best way to test an ordinary 2 μF condenser of an auto ignition system, and would this apply to condensers in general ?

How can the charge required to recharge a battery after use be estimated provided the discharge rate and length of discharge period are known ? How can I estimate the safe maximum charging rate ?

Grantham. P. J. HAGEN.

Electronics Exhibition

THE third annual Electronics Exhibition organized by the North West Section of the Institution of Electronics will be held at the College of Technology, Manchester, from 20th to 22nd July. There will also be an exhibition of scientific films arranged by the Manchester Scientific Film Society. Admission to the exhibition will be by ticket only and tickets may be obtained from Dr. J. A. Darbyshire, "Melandra," 1, Kershaw Road, Failsworth, Manchester.

Old Centralians

THE recently formed Midland Branch of the Old Centralians Association held its second annual dinner in Birmingham on 7th May, Mr. J. P. Clifton, branch chairman, presiding. All old students of the City an Guilds Engineering College, South Kensington, who would like to join the branch are invited to communicate with the hon. sec., Mr. A. A. Blanco, 99, Middleton Hall Road, King's Norton, Birmingham.

PERSONAL and SOCIAL

News of Men and Women of the Industry

FOLLOWING the appointment of **Mr. T. Lawrie** (secretary) as general manager of the North of Scotland Hydro-Electric Board, Mr. **W. D. D. Fenton,** B.SC., M.I.E.E., barrister-at-law, will now combine the duties of commercial engineer with those of secretary. Mr. Fenton was personal assistant to the general manager of associated companies of the Midland Counties Electric Supply Co., Ltd., before joining the Hydro-Electric Board. **Mr. H. W. Simpson,** assistant secretary, becomes deputy secretary.

Employees of Ferranti, Ltd., at the Moston, Hollinwood and Edinburgh Works, have presented a silver casket inscribed with the Ferranti arms, to **Sir Vincent Z. de Ferranti** to commemorate the conferment of his knighthood. Lady Ferranti was presented with a brooch. Nearly every employee of the three works contributed to the gifts. The casket was handed to Sir Vincent by four long-service employees at a ceremony held at the Hollinwood Works.

Following the handing over of the Maidstone Corporation electricity undertaking to the British Electricity Authority, the chief officials of the Corporation recently entertained **Mr. E. E. Hoadley,** the electrical engineer, to dinner at the Royal Star Hotel, Maidstone, when the town clerk presented him with an antique brass log box and companion set from his fellow officials.

Mr. H B. McKinty, who has been associated with Balfour, Beatty & Co., Ltd., for many years, has been appointed a director.

Mr. R. F. Hield has resigned his appointment as assistant works director for southern factories with Crompton Parkinson, Ltd., to join Veritys, Ltd., as general manager.

Mr. W. J. Selby has resigned from the board of the Power Securities Corporation, Ltd.

Mr. R. R. Martindale, deputy chief engineer (generation), British Electricity Authority, has been appointed to the Industrial Coal Consumers' Council set up under the Coal Industry Nationalization Act. Another member is **Mr. W. K. G. Allen,** joint managing director of W. H. Allen, Sons & Co., Ltd.

Mr. E. G. Yarrow, M.B.E., and **Mr. G. Sturrock Brown,** B.SC., have been appointed to the board of Yarrow & Co., Ltd.

Mr. J. T. Smith, assistant superintendent of Post Office telegraphs, Newcastle-on-Tyne, has been promoted superintendent and **Mr. J. Lawson,** of Whitley Bay, has been appointed assistant superintendent.

Mr. Bernard Kerby, press and public relations officer to the Chloride Electrical Storage Co. and its associated companies, is resigning his post and going to South Africa to take up permanent residence there for family health reasons. Until he secures a new job in the Union, he can be reached c/o Chloride Electrical Storage Co. South Africa (Pty), Ltd., 1301, Escom House, Rissik Street, Johannesburg. Mr. Kerby's successor will be **Mr. Richard Clements,** B.SC., a former editor of *Chemical Age.*

The Siemens Players (Music and Drama Section of the Siemens Sports Club) achieved another success with their production of the Ben Travers farce, "A Cup of Kindness," which they presented at their Sports Club Hall, Old Charlton, on 1st and 8th May. The leading roles of Fred Tutt, Charlie Tutt, Betty Ramsbotham and Mabel Ramsbotham were admirably sustained by Rudolf Chapman, Charles Hulford, Marjorie Killick and Margaret Hackett respectively, able support being rendered by Wilfrid Cornwell, Mary Mathias, Richard Luff, William Womack, Irene Loveless, George Millard, Margaret Slater, George Hoare and Clarence Nearn. The producer, Colin Scott, the stage manager Eric Raby, and his assistants, Nancy Cockburn and Pat Pacey are to be congratulated on the presentation.

Obituary

Ald. Sir Percival Bower.—We regret to record the death, which occurred on 7th May, of Ald. Sir Percival Bower, who was well-known for his activities in municipal, industrial and electricity supply affairs. He was born at Hythe, Kent, in 1880 and entered upon an engineering career. He became known as an able negotiator in engineering matters and during the 1914-18 war held many positions of an advisory character in connection with the production of munitions, the training of disabled Service men and other matters. His association with Birmingham municipal affairs commenced in 1919 when he was elected to the City Council. He was appointed an alderman and magistrate in the following year, and four years later became Lord Mayor. He was made an M.B.E. in 1920, a Chevalier of the French Legion d'Honneur in 1926, and was knighted in 1927. He was chairman of the Birmingham Electric Supply Committee for thirteen years, and had been prominent in the counsels of the

The late Sir Percival Bower

I.M.E.A. He was a past-president of E.D.A. and was at one time chairman of the General Purposes Committee of the Association of Municipal Corporations. His many other activities included membership of the Chelmsford Committee on the British Industries Fair. When Sir William Walker retired from the Central Electricity Board in 1944 Sir Percival Bower was appointed to succeed him as a member of the Board, and in the same year he retired from Birmingham municipal activities.

Mr. N. A. Enticknap.—We learn with great regret of the sudden death of Mr. N. A. Enticknap, joint secretary of the General Electric Co., Ltd., on 9th May. Mr. Enticknap's death at the age of fifty-seven deprives the company not only of one of its most talented executives, whose great wisdom and long experience in the handling of its finances will be sadly missed, but also of a man of great understanding and friendliness.

The late Mr. N. A. Enticknap

Mr. Enticknap joined the Audit Department of the G.E.C. in 1910 and went to Spain on behalf of the company in 1913 where, until the outbreak of war in 1914, he served as secretary of the Spanish subsidiary. During the inter-war years he frequently visited the Continent on business with the late Lord Hirst. In 1937 he was appointed assistant secretary, becoming joint secretary in 1943. He also held the appointment, since 1937, of directors' auditor of the G.E.C. pension fund.

In his younger days he was active sportsman, playing left back for the G.E.C. football team and showing considerable skill at swimming. He was treasurer of the G.E.C. Sports Club for thirteen years.

Mr. Enticknap leaves a widow, a son who is with the company, and two married daughters, one in Australia. The cremation took place on 14th May at Streatham Park Crematorium; among those who attended were Sir Harry Railing, chairman of the company, Mr. Leslie Gamage, joint managing director, and Mr. T. Dyke, joint secretary.

Mr. L. J. Hunt.—The death occurred at Clevedon, Somerset, on 14th May of Mr. Louis John Hunt, M.INST.C.E., M.I.E.E., who, until his retirement in 1945, was a director of the Electric Construction Co., Ltd. Previously he held positions as assistant in the designs department of Siemens Bros. & Co., Ltd., as manager and chief electrical engineer to Sandycroft, Ltd., and consulting engineer. He was patentee of several types of motor. In 1903, Mr. Hunt won the Derby Gold Medal of the Liverpool Engineering Society for a paper on the design of electrical machines and was also awarded the Hopkinson Premium of the I.E.E. for a paper on cascade motors. The funeral took place at Haywards Heath, Sussex, on Wednesday last.

Dr. W. Watson.—The death is reported from the United States of Dr. William Watson, a physicist who contributed much to the development of the thermionic valve and radio-telephony. Dr. Wilson was born at Preston, Lancs, in 1887, and was educated at Manchester and Cambridge Universities, working under Rutherford and J. J. Thomson. He was appointed lecturer in physics at Toronto University in 1912 but two years later joined the Western Electric Co. to carry out radio work, particularly research on vacuum tubes. He retired because of ill-health in 1942 but was able in 1945 to take up the post of professor of physics in the North Carolina State College.

Dr. Katherine Chapman.—The death has occurred of Dr. Katherine Mary Chapman, one of the first women medical radiologists in Glasgow. She was a lecturer in radiology, electro-therapy and diagnosis at Glasgow University.

Wills.—**Mr. Charles Davis Taite,** M.I.E.E., late managing director of the Lancashire Electric Power Co., and director of the Lancashire Electric Light & Power Co., who died on 1st February, left £21,715 gross (£21,257 net).

Mr. William Frederick Moir, chairman and managing director of Cryselco, Ltd., and former chairman of the Electric Lamp Manufacturers' Association, who died on 13th March, left £28,181 gross (£18,907 net).

Mr. Thomas Edward Pickford, of Mooring, Monks Road, Virginia Water, Surrey, electrical engineer, who died on 22nd January last, left £2,530 gross (£2,470 net).

Mr. C. L. Poyser, solicitor of the Central Electricity Board, who died on 20th January last, intestate, left £4,599 gross (£4,351 net).

Mr. M. M. Pulvermacher, A.M.I.E.E., who died on 22nd February last, left £2,512 gross (£2,449 net.)

Mr. Arthur Samuel Hooppell, A.M.I.E.E., of Grays, Essex, consulting electrical engineer, who died on 26th February last, left £1,037 gross (£522 net).

Mr. Frank Horspell, of Pudsey, Yorks., electrical engineer, who died on 23rd December last, left £2,098 gross (£2,049 net).

British Equipment Preferred

Mr. C. D. Elder, managing director of an Australian electrical group, recently left for London to place an order for £312,500 worth of electrical equipment. He said that the order was to be placed in Britain because "British equipment was second to none."

Industry and the House

Government and Nationalized Industries

By F. J. Erroll, M.A., A.M.I.E.E., M.P.

DESPITE the intention of the Government to keep the day-to-day affairs of the nationalized industries beyond the reach of Parliament as far as possible, matters affecting the British Electricity Authority are being discussed by both Houses of Parliament. In the Lords, Lord Lloyd initiated a short but useful debate on the position of redundant electricity employees under nationalization. He stressed the delay in framing the regulations called for in the Electricity Act and he suggested that 180 senior officers were likely to become involved, quite apart from the position of their immediate juniors.

Lord Chorley replied on behalf of the Government and he was able to give this reassurance: "We appreciate that there may be anxiety on the part of some people, although when they realize that there are unlikely to be more than a few cases in which loss of employment will occur, I think their anxiety will disappear." In support of this statement Lord Chorley pointed out that the industry is an expanding one and that the tendency will therefore be to increase staff. Although the Act became law on August 13th the vesting date was only April 1st so that there had not been much time to work out details.

Lord Swinton reminded the House that in the old days when Parliamentary franchises were given to railways or other authorities, Parliament had always been most careful to provide in the Act itself what the measure of compensation should be to persons who were displaced. Until the Government produces the regulations the matter must remain in the air.

Consultative Councils

In the Commons Mr. Palmer pressed the Minister of Fuel and Power to announce the names of the chairman and members of the Area Consultative Councils. Mr. Gaitskell hoped to be in a position to do so soon and to complete the list within a few weeks, especially as the increases in tariffs should provide the Councils with an immediate flow of complaints. That the matter is reasonably well advanced is shown by the publication of the regulations governing these Councils under the authority of Section 7 of the Act (referred to in the *Electrical Review* of 7th May).

In reply to Mr. Odey, the Member for Howdenshire, Mr. Gaitskell displayed the evasive tactics which have now become a familiar feature of the Parliamentary replies of Ministers responsible for nationalized industries. Mr. Odey wanted to know whether arrangements could be made to supply electricity to the village of Hotham. Mr. Gaitskell divested himself of responsibility by saying that this was a matter for the Yorkshire Electricity Board, to whom inquiries should be addressed, and in reply to a supplementary question, he suggested that Mr. Odey should himself deal directly with the Board.

Principle of Parliamentary Questions

Questions on the running of trains are similarly diverted by the Minister of Transport to the Railway Executive, although the Minister of Civil Aviation continues to accept fairly detailed responsibility for the State airlines. There are many people who say that nationalized industries cannot be run efficiently if they are exposed to daily Parliamentary questioning. It is worth while remembering, however, that during the whole of the war Parliamentary questions were permitted on any matter of detail or principle relating to the three fighting services. They were able to deal with them effectively, and there have been few complaints that such questioning adversely affected the conduct of our victorious military operations. The present Government will have none of it, and it will be interesting to see whether a Conservative Government will have the courage to reverse a principle which is being established by the present one.

In the debate on oil supplies much reference was made to the Government's change of policy over coal to oil conversion schemes, and they were criticized for sanctioning schemes which resulted in no increase in operational efficiency, but only in obtaining the thermal value of the oil. Mr. Gaitskell had nothing to say, for example, about the conversion of the Neasden power station of the London Passenger Transport Board, and he refused to be drawn on the future of

Bankside power station. At the time of the controversy the Government was able to dispose of the arguments about smoke and deleterious fumes by stating that the station would be oil-fired. In view of the growing shortage of fuel oil and indeed all petroleum products, this decision surely needs to be reconsidered. All that Mr. Gaitskell would say, however, in reply to a question was: "I have no statement to make about Bankside power station."

Members of all Parties are noticing the price increases for electricity which are being announced. In view of the Government's determined drive to reduce inflationary pressure, these increases could scarcely have come at a more unfortunate time, although it has been realized that an increase was overdue in any case. These increases are something of a windfall for Opposition speakers and for the Conservative Party throughout the country. Every nationalized industry has put up its prices shortly after taking over, and the British Electricity Authority is to be no exception. The public can scarcely be blamed if they draw the obvious conclusion that everything becomes more expensive under nationalization. It may be argued by the fair-minded in the industry that this is scarcely a just interpretation, but it is the stuff of which politics is made, and it is in any event well nigh impossible to explain on a political platform the technical and economic factors which surround a tariff policy.

Twenty members of the Parliamentary and Scientific Committee, visited the Atomic Energy Research Establishment at Harwell on 12th May, being received by Sir John Cockcroft. He personally conducted the party round the establishment and explained in the simplest possible language some of the remarkable developments which are taking place there.

PARLIAMENTARY NEWS

By Our Special Reporter

IN the House of Lords, Lord Lloyd asked the Government (1) why the regulations specified in the Electricity Act, 1947, section 55(1) had not yet been laid in draft by Parliament; (2) how many employees in the electricity supply industry were likely to suffer loss of employment or a worsening of their position in consequence of this Act and thus be eligible for compensation under this section; and (3) when these regulations would be laid before Parliament. He said that nine months had passed since the Act reached the Statute Book. Up to date no regulations, draft or otherwise, had materialized. Senior officials were in a complete state of uncertainty.

Lord Rennell said that there was unrest among people in the industry who were doubtful about their future. Before a scheme for taking over a big industry like this was brought forward in the form of a Bill, which subsequently became an Act, it would seem to be an elementary precaution to think out a scheme dealing with the persons concerned. If that were good commercial practice it would seem to be good criticism that the Government had not seen fit to follow it in respect of electricity. Lord Wolverton supported Lord Lloyd. Lord Elibank declared that this was a deliberate breach of undertakings on the part of the Government.

Lord Chorley, Lord in Waiting, said that, with regard to the charge of breach of faith, he would be glad of particulars. The industry was only taken over on 1st April and he was not in a position to give a firm date when the regulations would be forthcoming. Discussions had been going on with the representatives of the employees, but there were difficulties in getting agreement.

Lord Swinton said that he had a great deal to do with the Electricity Bill, and if he had not accepted at its face value the assurance that the Government were to be expeditious about this, the Opposition would not have accepted the proposal that these provisions about compensation should go into regulations.

Steel Supplies

Sir Patrick Hannon asked the Minister of Supply, if increased supplies could be made available for contracts in process in the building of power stations. Mr. John Freeman said that he was informed by the Minister of Fuel and Power that the amount of building steel allocated for power stations had recently been increased.

Mr. Hardy, asked the Secretary to the Treasury, whether, as steel production was now running at an annual rate of 15 million tons, allocations of steel to consumers were to remain on the basis of the target of 14 million tons.

Mr. Douglas Jay said that the main allocations were on a quarterly basis, and took full account of the expected supplies from home production and imports. The target of 14 million ingot tons for home production in 1948 was thought to be barely attainable when fixed. Owing to seasonal factors it was unlikely that the present rate could be maintained without interruption.

Electricians in Conference

Proceedings at Great Yarmouth

MR. JOHN FREEMAN, M.P., Joint Parliamentary Secretary to the Ministry of Supply, addressing the closing session of the policy conference of the Electrical Trades Union at Great Yarmouth on 14th May, predicted many years of prosperity for the electrical industry. There were, he agreed, difficulties at the present time in certain sections—he was anxious about some sections of the radio industry—and there would be minor difficulties on the fringe of the industry for some time. By and large, however, it was a healthy and prosperous industry and was likely to remain so.

Gas turbines for power generation were being developed and research was being devoted to atomic energy production.

Another speaker at the conference was Mr. E. W. Bussey, member of the British Electricity Authority and a former general secretary of the Union, who expressed the hope that the time had gone by when every demand from certain workshops and power stations would have behind it a threat of so many days' notice unless a favourable decision were given. Adequate machinery had been created for resolving labour problems and there was no necessity for that sort of action. It was intended to use this conciliatory machinery in its broadest sense and through it to set up rates and conditions which were fair and equitable to all concerned.

Health and Welfare

A new development, imposed by the Act on the Central Authority and Area Boards, was responsibility for health, welfare, education and safety of employees. This had not been possible with responsibility divided between hundreds of undertakings. The aim was to implement this section of the Act as quickly as possible.

Development of greater efficiency under the State would finally lead to the possibility of reducing electricity prices, or at least prevent further increases. Criticism had been made of the operation of nationalization, in view of proposed prices of electricity. But this was the aftermath of the old conditions; if nationalization had not come the increases would have had to be made by certain individual undertakings

During the week, the delegates, representing 170,000 members, debated numerous resolutions covering a wide range of subjects. An Executive Council motion reaffirmed the Union's principle of a 40-hour five-day week, but Mr. J. Humphrey (London), who moved it, said that this policy could not be pursued at the present time.

Delegates were assured by their president, Mr. Frank Foulkes, that the Executive would give full consideration to a resolution asking for a unified and standard set of rates and conditions within the nationalized supply industry, irrespective of geographical position, and demanding the immediate abolition of zoning in the industry.

Registration of Electrical Workers

A Willesden resolution calling upon the Executive to press for Government registration of all electrical operatives was carried by 137 votes to 37, in spite of Executive opposition. For the Executive Mr. L. G. Gregory (London) submitted that no useful purpose would be served in sponsoring such a move at the moment.

On broader issues, the conference approved an Executive Council motion, which urged the Government to improve the living standards of the workers as "vital to ensuring increased production"; to substantially reduce profit; to extend price control to unrationed non-utility and capital goods; to prevent employers from passing wage increases on to the consumer by raising prices; and to ensure that wages and living standards should have precedence over profit and unearned increments.

In moving the resolution, Mr. F. Haxell (London) said that of the 520 branches, 144 had sent resolutions opposing the Government's policy on wage stabilization. Only one branch had declared itself in favour. Mr. T. H. Nimmo (Birmingham), opposing, argued that it would be a mistake to try to get increased wages at this time as it would be an embarrassment to the Government. But Mr. C. Blackwell (Stretford) contended that many workers to-day were only getting a decent standard of living because they were on overtime.

Man-power Budget

A Central Planning Commission, charged with the task of drawing up a national economic plan including an overall man-power budget, was advocated in another Executive resolution. This resolution also suggested that the existing Planning Boards should be invested with enforcement rights in determining priorities and allocation of raw materials and the production targets required. Mr. W. C. Stevens, general secretary, proposing the motion, said that the present control was not sufficiently rigid to produce what was urgently needed by the country at the present time. Only two voted against it.

The conference also protested at the cuts in capital expenditure. Delegates, generally, expressed the opinion that the cuts would do immeasurable harm, particularly to their members in the shipbuilding and electrical contracting industries

Transformer Company's Jubilee

ON 10th May the British Electric Transformer Co., Ltd., Hayes, Middx, completed fifty years of transformer engineering which began in 1898 when the company was formed to manufacture the radial-type air-cooled transformer invented by Mr. A. F. Berry, who, in 1893, whilst a junior engineer with the London Electric Supply Corporation, became interested in the design of transformers. In 1895 he patented a design, but the anticipated performance was not realized. As a result of further work the radial design was developed and covered by patent No. 2801 in February, 1897. Mr. Berry left the London Electric Supply Corporation to specialize in transformer engineering. The first radials were manufactured under licence by Naulder & Harrison, Ltd., London, but Mr. Berry, foreseeing the demand for transformers, persuaded a group of business men to form a company, and in 1898 the British Electric Transformer Manufacturing Co., Ltd., as it was then called, started at the Globe works, Woodfield Road, London, with Mr. A. F. Berry as electrical adviser and Mr. G. Berry as chief assistant. By 1900 the Globe works were fully occupied and orders included three 20-kVA air-cooled 2,000/20,000-V, 50-cycle, single-phase units for the Marconi Co.'s wireless transmitter at Poldhu, Cornwall.

Inter-War Developments

In 1901 the company moved to the Hayes works and changed its name to British Electric Transformer Co., Ltd. Shortly afterwards Mr. F. E. Berry joined the firm. The company constructed one of the first on-load tap-changing equipments and more than £40,000 was paid by foreign electrical manufacturers to manufacture Berry transformers abroad. After the first world war the company was able to expand its works and provide for the development and manufacture of core-type transformers which were more suitable for three-phase application. The company began to develop a high-voltage booster regulator, and by the early nineteen-twenties it was supplying 30,000-kVA three-phase banks of radial transformers. Many large transformers were built for overseas and transformers with capacities not previously used in this country were made for the Central Electricity Board, for which the company has now installed more than three million kVA.

The next development was tap-changing switchgear of the drum-controller type. During the last war the company produced about 15,000 transformers of different types totalling more than three million kVA. At the present time work is in progress on units up to 60,000 kVA and the development of designs for voltages above 200 kV. To study surge phenomena at the higher voltages a new high-voltage laboratory is now being constructed. Of the three brothers responsible for technical development and expansion of the company Mr. A. F. Berry has now retired, Mr. G. Berry died in 1926, and Mr F. E. Berry is still a director. In 1932 the company became associated with Crompton Parkinson, Ltd.

Improving Coal Output

Comparison with Conditions in America

IN a Report to the National Coal Board on a visit to the United States, Mr. T. E. B. Young (production member) makes technical recommendations with a view to rapidly increasing the output of British mines.

Last year 550 million tons were cut by 450,000 men in the United States, compared with 189 million tons by 711,000 men in this country. Allowing for the greater proportion of coal-face workers to the total (72 per cent as against 20 per cent), the corresponding average outputs per man-shift are 6·4 tons and 4·5 tons. Greater mechanization should materially reduce the difference between "productive" and "non-productive" workers, but natural conditions here would prevent its elimination.

Little is to be learnt, it is stated, from American coal-face mechanization that is applicable to this country, but the introduction of electric trolley locomotives is considered highly desirable and roadways in new and reconstructed mines must be able to accommodate them. Man-riding must be provided to enable miners to get to their work more quickly. The possibilities of the consumption of untreated coal at power stations near to the sources of coal should be explored in association with the electrical industry.

The West Penn Power Co. (Pennsylvania) owns a 750,000-kW generating station and also a colliery which provides all the coal it requires. Although the ash content averages from 15 to 17 per cent, the untreated coal is consumed in specially designed boilers, all the heat value of the coal, middlings (intergrown coal and shale) and even shale itself being turned to account.

The status of mining engineers in this country, at all levels, should be such as to attract young men; promotion must be strictly on merit and not prejudiced by the existence of only one employer. Loading in all cases should be mechanized. With modern equipment thirty or forty pickers engaged on the separation of coal and dirt can be replaced by two or three skilled operators. Where the ash content in fines has to be reduced to the last degree with the smallest loss of coal in refuse, the tendency in the United States is towards the use of the concentrator table rather than froth flotation. At very few of the American mines visited is coal being loaded of larger size than 6 in. All shale and other impurities are removed mechanically, whereas at the great majority of British mines the separation (such as it is) of sizes over 4 in. is done by hand.

Paris Fair

Small British Representation in Electrical Section

(From Our Paris Correspondent)

THE 1948 Paris Fair is rather disappointing, as far as electrical exhibits are concerned, perhaps partly because the recent Arts Ménagers exhibition has taken the edge off expectations. Electrical and radio exhibits occupy the whole of the ground floor of the Grand Palais, Champs Elysées, and two-thirds of the balconies on the first floor, but there are few novelties shown.

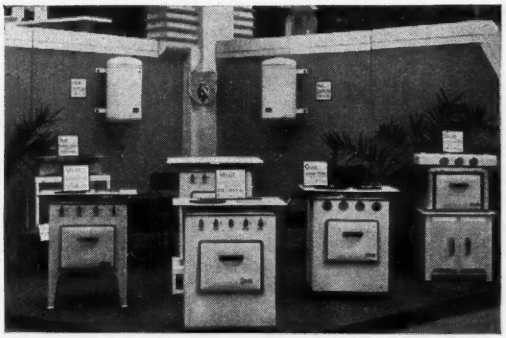
The French firm Les Diffusions Modernes is showing a recently perfected system of inter-house telephonic communication with microphones and loudspeakers so adjusted that conversations can be held over an area of one and a half square miles in offices and factories. The microphone is enclosed in a square case containing the switches and the loudspeaker is placed anywhere convenient in the office. Stable intercommunication can be established with one or several extensions without manual adjustment of the apparatus.

Out of the thirty-five British firms exhibiting at the Paris Fair only one is represented in the Electrical Section—Electrical & General Accessories, Ltd. (Leicester). The comparatively small stand is restricted to domestic appliances, conduit fittings and accessories, and to garage and workshop battery chargers and mains transformers. The domestic equipment includes a thermostatically controlled iron, and a chromium-plated milk boiler on the lines of a coffee percolator. Because the demonstrator thought he might have difficulty in obtaining the milk needed for demonstrations in Paris, he secured from the Ministry of Food a trade-size box of powdered milk for the purpose. A series of saucepans and cooking utensils are shown fitted with safety spring connectors.

A Paris company, A.P.I.A.D., has perfected a small electrical apparatus which can be screwed in place of scullery taps and supplies constant hot water. It can be used on 110/125 V (500, 800, or 1,200 W) or 220 V (800 or 1,200 W) circuits. The tap is constructed of insulating material. Water is hot in from 40 to 60 sec after the tap is turned on.

Among the large variety of electric cookers shown, many were adapted so that some plates used electricity and others butane gas, no doubt as a precaution against future electricity restrictions.

Sauter showed a mixed model with three electric plates and three gas burners and a "luxury" model which has the lower portion fitted to take kitchen utensils. The "Cusinus" "extra-luxury" model comprises two 1,800-W plates, a 1,500-W plate, a 1,000-W plate, and two ovens (2,000 and 1,200 W). The same firm



French cooker design exemplified at the Paris Fair (Eldor Calux)

shows the "Elida" washing machine with a 800-2,500-W heating element.

Othermo presents a heat-storage cooker with a loading of 1 kW supplemented by elements to provide extra heat for certain dishes. The four main elements are: a hot-plate taking up to six utensils, a spacious oven, a 45-litre water heater fed under pressure, giving 70 litres of water at 65 deg daily and a control which permits accurate regulation.

S.A.M.M. shows a casserole constructed on the haybox system which can be plugged into a point and a whole meal cooked. Marpel shows yet another mixed cooker with the top served by gas and an electric oven. Eldor shows the "Ignis" electric wafer maker.

Edla exhibits a large variety of ventilators, air purifiers and conditioners and heaters, and there are the usual water heaters for industrial and domestic purposes. Electric-Croissant shows an electric storage radiator working with 3, 5 and 6 kW elements. Plugged in at night for ten hours, the radiator gives a temperature between 14 and 20 deg C in a room 100 cu. m. for 14 hours, given an outside temperature of 2 to 5 degrees below zero.

Among other types of equipment there have been quite a number of electric deaf aids at the Fair this year, including the Ampli-Reseau (R.T.M.) which enables deaf people to use the telephone.

E.D.A.'s Future

Continuing Need for the Organization

THE valuable services the British Electrical Development Association could render in the nationalized electricity supply industry were stressed by speakers at the Association's British Industries Fair dinner held at the Queen's Hotel, Birmingham, on 11th May.

Proposing the toast of the Association, DR. P. DUNSHEATH, past-president of the Institution of Electrical Engineers and also a member of the London Electricity Board, said that although nationalization had altered circumstances, the fundamentals remained and in his view there was a very big future for the Association. Its psychological approach was of great value and the contacts and the goodwill built up were very important.

The I.E.E. and E.D.A. were to a large extent complementary, the former spreading technique and the latter spreading information in the more popular forms. E.D.A. also served as a link between the supplier and the consumer.

The lesson from the B I.F. was the extent to which this country depended on the export of brains. Means had to be found to make more electricity available so as to increase production. E.D.A. had achieved a very remarkable success and nationalization had not reduced the need for its services.

In reply, MR. J. ECCLES, chairman of the E.D.A. Council and of the Merseyside and North Wales Electricity Board, thought people were working just as enthusiastically for the new organization as they were before but they had to demonstrate that freedom and authority could run side by side. Efficiency and discipline had to be accompanied by giving personnel plenty of scope. He believed that the loose-coupled organization of E.D.A. was more suitable than direct publicity of the B.E.A. for contact with the consumer. Electricity would play a major part in the rehabilitation of British life and the re-establishment of British prestige.

MR. W. N. C. CLINCH, controller, Eastern Division, in proposing the health of the Midlands Electricity Board, said that the spirit of the electrical industry still remained despite nationalization and its obligations would still be carried out.

ALDERMAN W. S. LEWIS, chairman of the Midlands Board, who replied, suggested that a message should be sent to Mr. F. W. Lawton, controller, Midlands Division, wishing him a speedy recovery from his illness. Alderman Lewis said that the Area Boards, though autonomous, should not be too watertight and should not exclude outside opinions, particularly with regard to publicity. This should make for healthy competition between the Boards.

When the Midlands Board took over the electricity undertakings in its area, it was faced with a deficiency this year amounting to £790,000, of which Birmingham was responsible for £400,000. They had to make themselves financially sound, but the public would be agreeably surprised at the smallness of the increase in the electricity charges.

At the E.D.A. dinner : Mr. V. W. Dale, Mr. J. Eccles, Dr. P. Dunsheath, Alderman W. S. Lewis, Mr. H. F. Carpenter and Mr. D. H. Kendon

E.A.W. Area Conference

REPRESENTATIVES from all branches in the South East England Area of the Electrical Association for Women met for an Area Conference at the Association's headquarters on 11th May. Under the chairmanship of Mrs. L. M. Quick, delegates discussed many aspects of the Association's work. In the morning consideration was given to the Electricity Act and its implications. After an American buffet lunch, the subjects dealt with were "Constructing a Balanced Programme"; "The 'New Look' at Demonstrations"; "Films and Stills to aid Children Students and Teachers"; "The Value of Social Events in Branch Life"; and "How a Branch can start Educational Work." The proceedings finished with an amusing and instructive presentation of the point of view of "our dumb friends, the electrical appliances."

COMMERCE and INDUSTRY

Exports and Targets. Building Materials Control.

AN analysis of British imports and exports in the first quarter of 1948 published in the *Board of Trade Journal* gives the value of electrical goods and apparatus (excluding machinery) exported as £15,934,000. At 1938 prices the estimated value is put at £6,728,000, the index number of average values (1938=100) being 237. The index number of volume—198—compares with 179 in the fourth quarter of 1947.

The details in the accompanying table show progress towards export targets. The figures

Class of Equipment	Monthly Rates	
	First quarter, 1948	Target, end-1948
Electrical goods and apparatus:		
Wires and cables	1·57	1·95
Radio and radar apparatus	1·03	1·20
Telephone and telegraph apparatus	0·73	0·78
Electric lighting equipment	0·51	0·82
Batteries and accumulators	0·35	0·42
Other products	1·12	1·43
Total	5·31	6·60
Electrical machinery ..	2·34	2·45

for the first quarter are monthly rates of exports at current prices and the target figures are at end-1948 values, assuming a rise of 5 per cent in export prices during the year.

Price Stabilization

The Dynamo and Motor Association announces that in support of the Government's desire to stabilize prices, and in accordance with the recommendations contained in the report of the Federation of British Industries to the Government on prices and profits, its members have decided not to increase the present general level of prices of their motors and dynamos. The announcement, together with the names of the member companies, is published in our advertisement pages to-day.

Building Materials and Components

The Minister of Works has made the Control of Building Materials (Amendment) Order, 1948, the effect of which, as from 15th May, is to substitute a new schedule for that quoted in para. 1 of pamphlet B.M. 107. This includes metal conduit boxes, electrical, of types normally used for domestic purposes; metal conduit, electrical, of types normally used for domestic purposes; electrical plugs and socket outlets with or without switches, three-pin, up to and including 15 A; electrical main switches, switch fuses, and fuseboards up to and including 60 A of types normally used for domestic purposes; electrical switches, tumbler, wall type (surface, semi-recessed or flush) and ceiling types, up to and including 15 A of types normally used for domestic purposes. Pending the issue of revised forms, the existing forms B.M. 104 and B.M. 106 will continue to be used. Changes are also made in detailed procedure.

Steel for Fuel Saving Appliances

The Parliamentary and Scientific Committee recently submitted a report to the Chancellor of the Exchequer and the Minister of Fuel and Power urging that higher priority should be given for steel required for the manufacture, repair and maintenance of fuel saving appliances, particularly in the industrial sphere. The report assumed that an annual saving of some 18,000,000 tons of coal might be achieved if the full programme of re-equipping industry with up-to-date fuel-burning appliances were carried out.

Private Generating Plant

British Standard Code of Practice 323, "Private Electric Generating Plant," has been published and is obtainable at 2s. post free from the British Standards Institution. It covers both a.c. and d.c. machines up to 250 kW and 650 V driven by steam or internal-combustion engines. Recommendations relate to the selection of the plant, its layout and arrangement for facilitating a subsequent change-over to an alternative source of supply, and its location and housing. References to fire risk include data on fuel control and fuel drainage and on the installation of fuel tanks, flame-proof apparatus, fire-extinguishing equipment and fire alarms. Advice is included on many points of design, inspection, testing and maintenance.

X-Ray Equipment for Argentina

A large consignment of X-ray equipment was shipped recently in the s.s. *Highland Princess* for Buenos Aires. This equipment is worth £20,000 and consists of apparatus manufactured by Philips Electrical, Ltd., comprising six heavy-duty diagnostic units, six motor-driven tilting couches, and ultra-short-wave electro-medical treatment equipment.

Canadian Import Control

In the list of machinery which comes under Canadian import control as from 15th May, and for which importers must secure permits, are the following goods:—Electric vacuum cleaners and attachments, hand vacuum cleaners, and complete parts for the foregoing for production use; complete parts of domestic washing machines and clothes wringers for production use; sewing machines, other than domestic, with or without motive power unit

incorporated, and complete parts for production use ; diesel and semi-diesel engines and complete parts for production use ; air-cooled internal combustion engines of not greater than 1-h.p. rating; complete parts of radio apparatus for production use.—*Reuter* (Ottawa).

Since 1st April, contracts have been placed by the British Electricity Authority for generating station, switching and transforming station and transmission equipment amounting to £1,501,782. The principal contracts include:—Piping equipment, Barking.—Aiton & Co. Cast-iron segments for cooling-water system, Deptford East.—Stanton Ironworks. Circulating water pumps and equipment, Barking.—Drysdales. Station transformers and unit and auxiliary transformers, Keadby.—C. A. Parsons & Co. Concrete chimneys, Poole.—Tileman & Co. Circulating water pumps, transfer pumps and equipment, Skelton Grange.—W. H. Allen, Sons & Co. 132-kV and 66-kV switchgear, Colchester.—A. Reyrolle & Co.

Electricity Offices and Showrooms

The North Western Electricity Board proposes to build area offices in Union Street, Oldham.

Last Friday the Midlands Electricity Board officially opened new showrooms at Vesey Buildings, High Street, Sutton Coldfield.

Tour of Fylde Power Stations

Mr. George Gibson, chairman North Western Electricity Board, last week made a tour of the electricity stations of the Fylde coast from Lytham St. Annes to Fleetwood. He told the workers at St. Annes that the Board proposed to initiate an apprenticeship scheme.

Television Servicing Examination

Details and syllabus are now being issued by the Radio Trades Examination Board, 9, Bedford Square, London, W.C.1, as a preliminary toward the holding of an examination in television service work in May, 1950, or earlier, if there is a sufficient number of candidates. Success in the Board's radio servicing certificate examination is an essential qualification for admission to the television examination. The Board will also be publishing in September a revised booklet dealing with both the radio servicing and television servicing examinations, together with a list of schools and colleges offering coaching for the examinations.

Fire Protection

Particulars of a fire in a ship caused by the ignition of rubber are given by Dr. J. B. Firth in the first issue of the *F.P.A. Journal*, which is to be issued quarterly to members of the Fire Protection Association. The burning rubber dropped on to inflammable cargo in the hold either from gaskets guarding the union of a rubber-insulated flexible cable feeding a floodlamp or from the cable itself. Tests showed that if one lead of the cable were broken an arc should be maintained long enough to burn the insulation. Electricity was supplied at 220 V d.c., which experience of other fires shows to be more dangerous than a.c. in this respect. Another article contains notes on extinguishing fires in electric motors and on precautions that should be adopted for electrical installations in buildings of historic value.

High Purchase Tax Causes Dismissals

Two hundred and fifty women radio assembly workers at the Moston works of Ferranti, Ltd., have just been dismissed. An official stated that the majority of the dismissals were because of the crippling purchase tax increase.

Accessories Factory Extension

To meet the growing demand for its products both at home and abroad, Ashley Accessories, Ltd., has enlarged its factory at Ulverston, Lancashire, and the extension was recently officially opened by Lady Fraser, wife of Sir Ian Fraser, M.P. Mr. E. T. White presided at the opening ceremony, and made reference to the happy relationship which existed between the company and its employees. He was accompanied by the other directors, Mrs. E. T. White and Messrs. J. H. Petty, W. A. Shewan and J. C. M. Foxcroft.

Paper Salvage

Successful results in many directions are reported by the Waste Paper Recovery Association in its drive for improvement in paper salvage arrangements. All electrical firms are asked to assist in this latest campaign for the need for recovering waste paper is as great now as it was during the war. Advice and assistance are offered by the Association (52, Mount Street, London, W.1) particularly where collection difficulties are experienced.

Street Lighting in Buenos Aires

Among a number of fluorescent lighting installations supplied by the British Thomson-Houston Co., Ltd., is a street lighting system in the Calle Florida, Buenos Aires, the entire equipment for which was supplied by the company through its office in Buenos Aires. The installation work was carried out by the Buenos Aires Municipality. The Calle Florida, a long, narrow street famous as a shopping centre and catering for more pedestrian traffic than any ten other streets in Buenos Aires, may well be compared with Old Bond Street. A total of fifteen B.T.H. fluorescent street lighting lanterns, each accommodating three 80-W, 5-ft " warm-white " fluorescent lamps, together with the auxiliary gear, have been suspended on twin catenary wires 25 ft (7·6 m) above the centre of the roadway at intervals of 80 ft (24·4 m). Each lantern has a carefully designed reflector system and the lamps and reflectors are

protected from dust and weather by a clear plastic cover which is clamped to the body of the lantern by means of four toggle catches. Two hinged end-covers facilitate lamp changing and starter switch maintenance. Despite the low brightness light source, anti-glare shields are incorporated; these act as a dual safeguard against glare, and at the same time give controlled cut-off. The overall result is that 97 per cent of the total light output of the lantern is directed below the horizontal. The total output of the three 5-ft fluorescent lamps is 9,120 lumens (average throughout life) and this, coupled with an overall efficiency of the lantern in the region of 68/70 per cent, gives a total average lantern output of 6,110 lumens, 6,000 in the area of utilization.

Fluorescent Lighting Installation

The Cadbury's Food Hints Centre in Oxford Street, London, is illuminated entirely by Ionlite 150-W cold cathode fluorescent lighting units. The "warm white" and "off-white" colours used, and the modern lines of this equipment, produce an effect which blends admirably with the general appearance of the centre.

Dissolution of Partnership

Messrs. S. Whitton, L. Whitton and J. R. Parkin, trading as **Fred Whitton & Sons**, constructional electrical engineers, at 64, Morris Lane, Kirkstall, Leeds, have dissolved partnership. Messrs. S. Whitton and L. Whitton will attend to debts and carry on the business under the same title.

Trade Publications

Johnson & Phillips, Ltd., Charlton, London, S.E.7.—Illustrated brochure technically describing the construction, jointing and properties of power cables sheathed with seamless aluminium tube.

Jenson & Nicholson, Ltd., 36, St. James's Street, London, W.1.—Brochure surveying industrial finishing processes.

Cobra (Wood Treatment), Ltd., 84, High Street, Braintree, Essex.—Technical brochure on the preservation of wood poles.

Annual Holidays

British Insulated Callender's Cables, Ltd., is closing its Anchor Works, Leigh, for the annual holidays from 3rd to 10th July. The Prescot and Helsby Works, and the Willenhall Foundry, will be closed from 24th July to 2nd August. All dates are inclusive. The Erith works will not close as holidays will be staggered.

Trade Announcements

Mr. W. H. Evans has joined **F. Westerman (Wholesale), Ltd.**, as representative for the South Wales area, taking over from Mr. G. E. B. Holt, so that the latter can devote more time to the remainder of his territory.

Electrical Machinery Traders

ADDRESSING the third annual meeting of the Association of Electrical Machinery Traders on 11th May, the chairman, Mr. W. E. Lawton (Industrial Electrical Co., Ltd.), said that close touch had been maintained with the two departments of the Ministry of Supply concerned with the disposal of surplus industrial electrical equipment and other Government Departments.

A questionnaire on the subject of members' reconditioning and testing facilities was to be distributed to members. The results would help the secretary, who was continually being asked for information on these subjects. Meetings held in the provinces had been well attended. The Association now had 88 members. Their primary object was to raise the status of electrical machinery traders and those who joined would be expected to trade in a manner creditable to the industry and the Association.

It was intended to continue their advertising campaign and proposals for financing it were being made by the treasurer, Mr. Holding. In conclusion, Mr. Lawton said that having held the office of chairman for three years he thought that somebody else should step into the position.

The report was approved and Mr. L. Bowers (R. F. Winder, Ltd.) was appointed chairman for the ensuing year. Mr. Lawton was thanked for his valuable services and unanimously appointed first president of the Association. Mr. T. A. Atkinson (Dynamo & Motor Repairs, Ltd.) was appointed vice-chairman and Mr. G. H. Holding was reappointed treasurer.

The articles of association were amended to provide for a different basis of subscription. The question of affiliation to the Federation of British Industries was held over for the time being.

Trade Marks

APPLICATION has been made for the registration of the following trade marks. Objections may be entered within one month from 12th May:—

VACTRIC. No. 657,251. Class 7. Washing, hair-drying and mixing machines: cleaning and polishing machines and parts included in Class 7. —Vactric, Ltd., 1, Langham Place, W 1.

CONVOTOOL (design).—No. 656,977. Class 9. Apparatus for charging electric batteries.—Automatic Electric Co., Chicago. Address for service: c/o Frank B. Dehn & Co., Kingsway House, 103, Kingsway, W.C.2.

GRAFTON. No. 657,204. Class 9. Electric flat irons and kettles.—R. H. Gullet and R. A. H. Gullet, trading as the Grafton Heater Co., 133-41, Rosebery Avenue, E.C.1.

REXONAX. No. 658,875. Class 9. Instruments and apparatus for use in telegraphy, telephony, radio-telegraphy, radio-telephony, television, sound producing, etc.—N. C. Mordaunt, Lowther House, St. Mark's Road, Bromley, Kent.

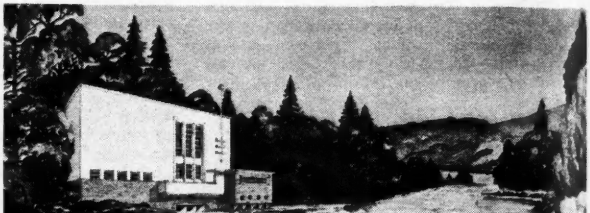
Highland Electricity

Glen Garry and Glen Moriston Schemes

THE North of Scotland Hydro-Electric Board has published two Schemes which will utilize the water-power resources of Glen Garry (Constructional Scheme No. 24) and Glen Moriston in Inverness-shire (Constructional Scheme No. 23).

The development of these waters was covered by the West Highland Power Bill of 1928 and the Caledonian Water Power Bills of 1936, 1937 and 1938, which failed to receive the approval of Parliament.

The Garry scheme is estimated to cost £4·85 million and will utilize a catchment area of 151 sq miles (391 sq km) to produce an average annual output of 170 million kWh. At the eastern end of of Loch Quoich a dam, 806 ft (245·6 m) long and 107 ft (32.6 m) high, will be built, the water from which will be led to a 20,000-kW generating station, discharging into Loch Poulary, on the River Garry. At the eastern end of Loch Garry will be a dam 1,026 ft (312·7 m) long and 84 ft (25·6 m) high; from there the water will be conveyed to the 20,000-kW Invergarry power station under a 218-ft (66·4 m) head on the north bank of the River Garry.



The proposed Invergarry power station

The Moriston project (including Lochs Cluanie and Loyne) will utilize the resources of 158 sq miles (409 sq km) of catchment for the production of about 214 million kWh per annum at a total estimated cost of £8 million. Four dams and four generating stations, with a total installed capacity of about 56,000 kW, will be built.

Loch Loyne will be raised by a dam, 1,542 ft (470 m) long and 61 ft (18·6 m) high, and the impounded water will be conveyed to Loch Cluanie where a second dam, 2,015 ft (614 m) long and 108 ft (33 m) high, is to be constructed, and thence to a 17,500-kW power station near Ceannacroc Bridge. A subsidiary power station, to utilize the waters of the upper catchment of the River Dee, will be built to the north of the Ceannacroc station. Its discharge will be led into the tunnel between Cluanie and Ceannacroc and utilized again in the Ceannacroc power station.

On the lower reach of the River Moriston it is proposed to construct two dams; one near Dundreggan, 367 ft (112 m) long and 34 ft (10·3 m) high, will serve a 13,000-kW power station and the other, the Moriston Dam, 658 ft (200 m) long and 95 ft (29 m) high, a 20,000-kW station. Another subsidiary generating station at Livishie near the Moriston Dam will utilize water from a number of streams which at present flow into the River Moriston and Loch Ness.

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LONDON. — Electrodepositors' Technical Society, 1.50 p.m. Visit to United Flexible Tubing Co., Ltd., Ponders End, Middlesex, 6 p.m. Northampton Polytechnic, St. John Street, E.C.1. Spring meeting. "Continuously Electroplated Steel Strip and Sheet," by A. Smart.

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BELFAST.—Queen's University, 6.45 p.m. I.E.E. Northern Ireland Centre. Annual general meeting.

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MANCHESTER. — Engineers' Club, Albert Square, 12.45 p.m. North Western Fuel Luncheon Club. Luncheon. "The Exploration of Oil in Great Britain," by Dr. G. M Lees.

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Company News. Stock Exchange Activities.

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In his statement issued with the report and accounts, Sir Claude Gibb (chairman and managing director) says there has been a substantial increase in output and in the large reconstruction, re-equipment and expansion programme which has been proceeding for more than two years. Manufacturing costs have risen at a much faster rate than selling prices, and the future prospects in the export market are causing the directors considerable concern. There is ample evidence that export markets for many consumer goods are reaching saturation or are beginning to receive their needs from the countries' own production. In the case of capital goods such as their company manufactures, however, the production equipment is very expensive to provide and does not contribute directly to defence potential. Hence, more than ever before, the exports of Britain must depend on the capital goods industries for great help. If Britain's heavy electrical industry is to compete in world markets it must have as its manufacturing tools adequate research for, and competent designers of, efficient products, modern and constantly improving production plant, skilled mechanics, and raw materials supplied at prices comparable with those available to their competitors. Production of the company so far in 1948 augurs well for another year of record output.

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At the annual meeting to be held on 2nd June a resolution will be submitted for increasing the capital of the company to £10,000,000 by the creation of a further 5,000,000 shares of £1 each to be issued at such times and on such terms as the directors shall think fit.

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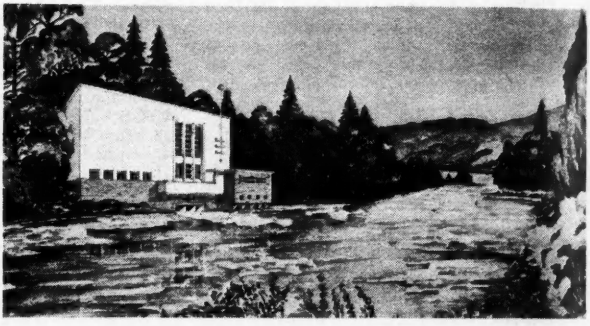

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of 800,000 4 per cent cumulative preference shares of 20s. each at a slight premium. 400,000 shares will be made available for applications received by the company in Kenya Colony and preferential consideration will be given to applications from existing shareholders.

Charles Clifford & Son, Ltd., report a net profit for the year ended 31st December last of £48,231, as compared with £25,748 for the preceding year, to which is added £35,925 brought in, making £84,156. It is proposed to pay a second interim ordinary dividend of 2s. 6d. per share, maintaining the distribution for the year at 3s. 6d. per share, free of tax. General reserve receives £30,000 and the balance carried forward is £42,666.

Veritys, Ltd., report a trading profit for 1947 of £39,725, which includes £15,341 relating to previous years and £10,000 transferred from contingencies reserve to cover estimated loss of earnings during the fuel crisis. Depreciation absorbs £10,000 and taxation £8,000. It is proposed to pay a dividend of 5 per cent for the year (against 2½ per cent). For the previous year the trading profit was £1,573. Depreciation required £8,000 and taxation £1,213, leaving a loss of £7,640. The credit balance carried forward, after deducting net loss and the 2½ per cent dividend was £6,419.

Laurence, Scott & Electromotors, Ltd.—Speaking at the annual general meeting, Mr. G. H. Wilson, chairman, said it was interesting to consider the content of their sales: Materials and services represented 48·5 per cent, wages and salaries 41·2 per cent, taxation on profit 5·2 per cent, share redemption and pension funds 1·4 per cent, reserves and depreciation 2 per cent and profit distributed to shareholders 1·7 per cent. It could hardly be maintained that the last item was excessive, and incidentally the corresponding figure in 1938 was 4·6 per cent, whereas the materials and wages content was almost precisely the same as now, which showed clearly that selling prices had not been increased disproportionately to costs.

The National Electric Construction Co., Ltd., records a revenue of £89,463 for 1947, compared with £66,771 in 1946. The profit, after taxation, was £44,706 (£37,966). After maintaining the dividend at 10 per cent the balance of £34,531 goes to the undivided profits account which now stands at £284,060.

The B.E.T. Electricity Supply Co., Ltd., reports revenue for the year ended 1st March last of £56,857, as compared with £92,717 for the preceding year, and a net profit of £28,026 (against £45,804). The dividend for the year remains unchanged at 5 per cent and £41,917 is carried forward (against £34,489 brought in).

The River Plate Electricity & Other Securities Corporation, Ltd., reports a net profit for 1947 of £37,486, as compared with £39,740 for 1946. The dividend for the year is maintained at 8 per cent by a final payment of 5 per cent.

The Plessey Co., Ltd., has declared an interim dividend of 10 per cent (unchanged).

Marco Refrigerators, Ltd., have increased their interim dividend from 7½ to 12½ per cent.

Companies to be Struck Off Register

The following companies will be struck off the Register after expiration of three months from 14th May unless cause is shown to the contrary:—Central Radio & Television, Ltd.; Electric Automatic Controllers, Ltd.; and George Martin's Electrical & Radio, Ltd.

Winding-up Petition

Bex Electric, Ltd.—A petition for the winding-up of the company was presented to the High Court on 11th May by F. H. Wheeler & Co., Ltd. Any person intending to appear at the hearing must write to the petitioners' solicitors, George Martin & Co., 32, Victoria Street, Westminster, S.W.1, by 29th May.

Meeting of Creditors

Kalgoorlie Electric Tramways, Ltd.—A meeting of creditors is to be held on 8th June at the company's registered office, 1, Broad Street Place, London, E.C.2.

Liquidations

Incorporated Association of Electric Power Companies.—Particulars of claims by 8th June to the liquidator, Mr. J. Paterson, 559, Abbey House, Victoria Street, London, S.W.1.

Antrim Electricity Distribution Co., Ltd.—Winding-up voluntarily. Joint liquidators, Messrs. W. J. Coad and S. H. Coombe, 88, Kingsway, London, W.C.2.

Garden Vale Room & Power Co., Ltd.—Winding-up voluntarily. Liquidator: Mr. J. Stansfield, 68, Albert Road, Colne, Lancs.

British Electronic Products, Ltd.—Meeting, 14th June, at Brereton Road, Rugeley, Staffs. to receive an account of the winding-up by the liquidator, Mr. J. A. Stokes.

Bankruptcies

H. C. Scholes, residing at 37, Albany Road, Chislehurst, Kent, and lately carrying on business as the proprietor of Scholes' Electric Co., 72, High Street, Sidcup, Kent, electrician. —Last day for receiving proofs for dividend 28th May. Trustee, Mr. A. M. Lander, 280a, High Street, Rochester, Official Receiver.

L. R. Maddock, described in the Receiving Order as Maddock Brothers (a firm), formerly residing and carrying on business at 22, Fox Hey Road, Wallasey, Ches., now residing at 9, Saltburn Road, Wallasey, and carrying on business at 7c, Block A, The Temple, 24, Dale Street, Liverpool, as Maddock Brothers, electrical contractors.—Trustee, Mr. P. S. Booth, 5, Rumford Place, Liverpool, released 21st April, 1948.

STOCKS AND SHARES

EVERY week adds evidence of the amount of money which is awaiting investment, or employment in some more profitable manner than that of earning deposit-interest in a banking account. The two nationalization stocks, Transport and Electricity, have recovered from the weakness which beset both of them soon after they were issued. Owing to substantial purchases on behalf of what may be called safety-first money, the quotation of the Electricity stock is steadily approaching par.

Home and American Industrials

Many of the ordinary shares in front-rank industrial companies still pay under 4 per cent on the money, although in a great number of cases any hope of early dividend increase is, of course, no longer feasible under the voluntary limitation of dividends that has been imposed by the companies themselves. When the once-for-all capital levy was announced, a certain amount of selling followed, but this source of supply seems to have come to an end, at least for the time being. American securities, industrial and other, are advancing rapidly as a result of the dollar premium that shows a constant tendency to rise.

Cable Earnings

Johnson & Phillips accounts showed that, as the result of the rise in profits during 1947, the 15 per cent dividend was covered by distributable earnings equal to 38 per cent on the ordinary capital. The balance-sheet shows the latter enlarged by the 67,000 shares issued a year ago to Telegraph Construction in exchange for 100,000 of that company's shares. Consolidation of the accounts has been deferred until next year in view of the take-over of the electricity undertakings. Henley's remarkable results for 1947 were calculated to produce earnings of just about 100 per cent on the ordinary capital as it stood before the new issue, which latter did not rank for the 20 per cent paid. Active conditions in the cable industry, coupled with the impressive balance-sheets and conservative dividends of the leading companies, are fully maintaining the popularity of the shares concerned. This is witnessed by yields of only 4 per cent on Henleys at 25s., and a fraction more on Johnson & Phillips at 73s. 9d., Enfields at 37s., and others of similar calibre.

Changes on the Week

A rally of 1s. 6d. lifted the price of H.T.A. to 20s., and amongst other improvements Thomas Tilling stand out with a florin gain at 99s. At 1815 British Electric Traction deferred is 15 points up. Oriental Telephone hardened to 54s., Ever Ready to 38s. 6d. and Mather & Platt to 54s. 6d. International Tel. & Tel. at 24 are $4 higher, in sympathy with other Americans. Canadian Marconi are 3s. 9d. up, at 13s. 9d. Fluctuations in Tube Investments left the price 2s. 6d. down at 6$\frac{15}{16}$. Victoria Falls at 7$\frac{9}{16}$ are $\frac{1}{8}$ easier. British Aluminium 50s.*6d., Telegraph Constructions 50s., and Globe Telegraph ordinary 47s. are better on the week. Crabtrees at 43s. have gained 6d.

Company News

With a distribution of 5 per cent, Veritys have gone half-way to restoring the rate to the 7$\frac{1}{2}$ per cent dividends paid for a succession of years up to 1946. In that year, the net result was a loss of £7,600 and a cut in the dividend to 2$\frac{1}{2}$ per cent. The 5s. shares are quoted at their par value. The Telephone Manufacturing final dividend of 6$\frac{1}{2}$ per cent, which again makes a total of 9 per cent for the year, is paid on capital increased since last year by the issue of 460,000 new 5s. shares, bringing the total to £500,000. These were offered to shareholders a year ago at 10s., which is 6d. less than the present price. The yield comes to £4 5s. 9d. per cent. Calcutta Electrics have relapsed 4s. to 42s. 6d. since mention in the annual report of new capital requirements up to £6 millions over the next few years. Palestine Electrics rose 2s. 6d. to 32s. 6d. on the political developments.

Aberdare Cables

A scramble occurred in the Stock Exchange last week for the newly marketed £1 shares of Aberdare Cables, at the opening price of 58s. 6d. After rising almost immediately to 65s., the price has since settled down in that neighbourhood. In the advertised particulars of the issue, the directors forecast the maintenance of the dividend at the rate of 15 per cent paid for the year ended last October, when profits amounted to about double the gross distribution. At that rate, the shares would pay £4 12s. 3d. per cent (at 65s.) on the money. Last year, the company's sales, it is stated, reached the record figure of over £1$\frac{1}{2}$ millions: orders on hand are higher than they were a year ago, and about 40 per cent are for export.

American Influence

American buying is responsible, according to market report, for an outburst of activity in certain radio and other shares favoured by transatlantic speculators. As a result of this attention, Scophony shares, for instance, were hoisted from 2s. 6d. to 3s. 3d. at one time, relapsing later to 3s. middle. Cinema Television "B" shares were also singled out, rising in consequence from 3s. to over 4s. in the course of a few hours. They are now 3s. 9d. E.M.I. were put up 2s. 6d. to 20s. 3d. and, on profit-taking sales, reacted to 19s. 9d. There was a sympathetic improvement in other radio shares, which had been depressed under reports of trading difficulties at home because of the purchase tax, and abroad through import restrictions. The full extent of the improvement was, however, not sustained. Cossors are 1s. 6d. up at 12s. after rising to 12s. 3d. E. K. Cole at 14s. 6d. show a rally of 9d.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1942

METROPOLITAN-VICKERS Electrical Co., Ltd., and G. J. Scoles.—"Circuit arrangement for discriminating between frequencies of alternating or pulsating electrical energy." 8855. 26th June, 1942. (601204.)

W. J. O'Brien.—"Neutralized thermionic amplifiers." 14526. 5th August, 1941. (601205.)

J. Foreman.—"Electron discharge device." 16030. 12th November, 1942. (601206.)

J. Foreman.—"Electric oscillation generators. 16593. 23rd November, 1942. (601208.)

M-O Valve Co., Ltd., D. A. Boyland and R. W. Sloane.—"Magnetrons." 17706. 12th December, 1942. (601102.)

1943

Plessey Co., Ltd., and E. R. Wellburn.—"Electrical condensers." 20766. 11th December, 1943. (601052.)

1944

H. B. Radley.—"Spacing of elements, such as the electrodes of electron discharge devices, in envelopes." 646. 12th January, 1944. (601104.)

Electric Transmission, Ltd., K. Dannenberg and O. H. Hosking.—"Device for earthing high-voltage overhead transmission lines and other electrical apparatus." 7833. 26th April, 1944. (601215.)

Dubilier Condenser Co. (1925), Ltd., Steatite & Porcelain Products, Ltd., and P. R. Coursey.—"Electrical condensers." 18022. 21st September, 1944. (601220.)

Steatite & Porcelain Products, Ltd., Dubilier Condenser Co. (1925), Ltd., J. A. Sugden and P. R. Coursey.—"Electric condenser systems." 18023. 21st September, 1944. (601109.)

Standard Telephones & Cables, Ltd.—"Couplings for cooling conduits of high-frequency apparatus." 18027. 25th November, 1943. (601221.)

Berkeley & Young, Ltd., and G. L. A. Grundon.—"Electric fans." 18979. 4th October, 1944. (601222.)

Sperry Gyroscope Co., Inc.—"Electromagnetic wave energy transfer devices." 20803. 26th October, 1943. (601251.)

W. W. Triggs (Farnsworth Television & Radio Corporation).—"Radio receiver for simultaneously receiving signals of different types." 23706. 28th November, 1944. (601227.)

1945

British Thermostat Co., Ltd., W. F. F. Martin-Hurst, E. J. Bush and E. McGowan.—"Thermostatic control devices." 1027. 12th January, 1945. (Cognate applications 1176/45 and 1178/45.) (601119.)

Igranic Electric Co., Ltd.—"Apparatus for maintaining a variable at a substantially constant value." 3296. 9th February, 1944. (601121.)

Callender-Suchy Developments, Ltd., and K. T. Suchy.—"Electronic valves." 4371. 21st February, 1945. (601230.)

Standard Telephones & Cables, Ltd., C. W. Earp and and C. M. Kramskoy.—"Frequency measurement." 5511. 5th March, 1945. (601154.)

Electrical & Musical Industries, Ltd., and E. L. C. White.—"Television receiving systems." 6445. 14th March, 1945. (Addition to 517170.) (601060.)

H. R. Whitfield and J. M. Daniels.—"Thermionic valve circuits for detecting an amplitude-modulated pulse train." 8482. 5th April, 1945. (601124.)

H. R. Whitfield.—"Radar systems." 8483. 5th April, 1945. (601125.)

Standard Telephones & Cables, Ltd.—"Position indication systems." 10026. 28th April, 1944. (601255.)

Marconi's Wireless Telegraph Co., Ltd.—"Frequency control of oscillation generators." 11647. 6th May, 1944. (601164.)

P. Raibourn.—"Pick-up or relay system using modulated light beams." 11897. 11th May, 1945. (Convention date not granted.) (601237.)

E. J. Timberlake.—"Means for improving voltage regulation in alternators." 12049. 14th May, 1945. (Addition to 553445.) (601238.)

Standard Telephones & Cables, Ltd.—"Arrangements for demodulating duration modulated pulses." 13867. 29th July, 1944. (601128.)

Standard Telephones & Cables, Ltd.—"Electric multi-channel pulse communication systems." 13868. 29th July, 1944. (601129.)

Callender's Cable & Construction Co., Ltd., L. G. Brazier and D. T. Hollingsworth.—"Sealing ends for electric cables." 15959. 22nd June, 1945. (601259.)

Metropolitan-Vickers Electric Co., Ltd., and D. M. Smith.—"Internal-combustion turbine plant for propulsion." 16553. 28th June, 1945. (601170.)

E. Parker and J. Buckingham.—"Electronic amplifiers." 16700. 30th June, 1945. (601171.)

J. E. Carter.—"X-ray apparatus." 17053. 4th July, 1945. (601262.)

W. R. Steele.—"Electrically operated remotely controlled valves." 17493. 9th July, 1945. (601172.)

Aircraft-Marine Products, Inc.—"Apparatus for crimping electrical connectors on to electrical conductors." 17537. 15th July, 1944. (601068.)

British Thomson-Houston Co., Ltd., and L. Griffiths.—"Ignition devices." 17803. 12th July, 1945. (601264.)

Philco Radio & Television Corporation.—"Electric vacuum tube oscillator and super-regenerative receiver circuits." 18132. 15th July, 1944. (601069.)

Hussmann-Ligonier Co.—"Refrigerated display case." 18331. 31st July, 1944. (601133.)

Standard Telephones & Cables, Ltd.—"Automatic position control apparatus." 18641. 28th July, 1944. (601134.)

Marconi's Wireless Telegraph Co., Ltd.—"Heat detection devices." 18981. 20th December, 1943. (601070.)

Standard Telephones & Cables, Ltd.—"Electric pulse modulating systems." 19333. 29th July, 1944. (601135.)

Metropolitan-Vickers Electrical Co., Ltd., and H. K. Ramsden.—"Automatic acceleration control systems for electric traction motors." 19479. 30th July, 1945. (601175.)

A. J. H. Oxford.—"Pulse lengthening circuits and radar systems embodying such circuits." 20645. 10th August, 1945. (601136.)

L. B. Mullett.—"Electromagnetic waveguides." 20949. 14th August, 1945. (601269.)

British Thomson-Houston Co., Ltd.—"Dies for coating wire." 21466. 23rd August, 1944. (601271.)

Calor Soc. Anon. pour la Fabrication des Appareils de Chauffage et des Appareils à Usages Domestiques par L'Electricité.—"Heating element for electric kettles." 21530. 27th March, 1942. (601272.)

Bendix Aviation Corporation.—"Earth-inductor compasses." 24009. 2nd September, 1944. (601180.)

Standard Telephones & Cables, Ltd.—"Radio systems for providing a zone indication about an airport." 25310. 2nd October, 1944. (601277.)

J. T. King.—"Aircraft lighting systems." 25715. 3rd October, 1945. (601079.)

M. J. De Groot.—"Electrical weighing apparatus." 26335. 14th June, 1941. (601083.)

Aktiebolaget Elecktrolux.—"Absorption refrigerating apparatus." 27472. 6th December, 1944. (601085.)

British Thomson-Houston Co., Ltd.—"Projection lamps." 28517. 4th November, 1944. (601281.)

C. Crampton, W. Struszynski and C. S. Wright.—"Radio direction-finding systems, particularly for use at high frequency. 29089. 2nd November, 1945. (601096.)

Dubilier Condenser Co. (1945), Ltd. (W. Dubilier).—"Electrical condensers." 30241. 12th November, 1945. (601195.)

Brookhirst Switchgear, Ltd., and C. Morrey.—"Electric switches and switchgear." 30708/9. 16th November, 1945. (601138/9.)

A. C. Cossor, Ltd., B. C. Fleming-Williams and A. Allen.—"Equipment for determining the distance of bodies by means of radio waves." 31257. 20th November, 1945. (601289.)

F. G. Bac.—"Electric plug and socket couplings."

31541. 3rd November, 1944. (Cognate application 31542/45.) (601294.)

British Insulated Callender's Cables, Ltd., and F. S. Smith.—"Arrangement for detecting flow and the direction of flow of fluid in electric cables and pipe lines." 32015. 27th November, 1945. (601298.)

M. P. Winther.—"Electrical governors." 34863. 16th May, 1942. (601143.)

1946

M. P. Winther—"Electronic voltage stabilizing apparatus." 654. 16th May 1942. (601144.)

M. P. Winther.—"Electric coupling control apparatus." 655. 26th January, 1944. (601241.)

General Electric Co., Ltd., N. A. Wooster, W. A. Wooster, J. L. Rycroft, L. A. Thomas, and E. A. Fielding.—"Manufacture of piezo-electric crystals." 2227. 23rd January, 1946. (Addition to 580965.) (601243.)

A. F. Coates.—"Controllers for lifts." 3707. 6th February, 1946. (601244.)

Teddington Controls, Ltd., and E. J. Bush.—"Thermostatic control devices." 6427. 1st March, 1946. (601145.)

Philips Lamps, Ltd.—"Incandescent cathodes for use in gas or vapour filled discharge tubes." 22917. 27th March, 1940. (601200.)

1947

National Cash Register Co.—"Apparatus for generating electrical impulses." 8093. 27th December, 1943. (Divided out of 601122.) (601147.)

National Cash Register Co.—"Apparatus for generating electrical impulses." 13673. (27th December, 1943. (Divided out of 601122.) (601148.)

National Cash Register Co.—"Distributors for routeing electrical impulses." 13674. 27th December, 1943. (Divided out of 601122.) (601149.)

Hussmann Refrigerator Co.—"Refrigerated display cases." 26953. 31st July, 1944. (Divided out of 601133.) (601150.)

ELECTRICITY SUPPLY

Big Development Schemes in Australia and Canada

Glasgow. — CHANGE-OVER. — The general manager of the Dalmarnock Chemical Works is to arrange with the City Engineer's Department Central Workshops Section for the installation of new cables, fittings and switchboard at the chemical works, consequent on the change-over from d.c. to a.c. at an estimated cost of £300.

Hyde. — STREET LIGHTING. — The Town Council is to ask the Ministry of Transport to approve a scheme for the provision of 104 new street lighting points costing £8,000.

Mansfield.—SUPPLY TO HOUSING ESTATE.—The Corporation has received sanction to the the borrowing of £3,888 for the provision of an electricity supply to fifty "Orlit" type houses on the Abbott Road site.

Overseas

Australia.—VICTORIA SCHEME.—The Victorian Cabinet has approved the expenditure of £45,000,000 on the development of brown coal deposits at Morwell and extension of the hydro-electric installations at Kiewa. A Bill is also to be introduced to increase the State Electricity Commission's borrowing powers from £20,000,000 to £65,000,000. A new 70,000-kW generating station is to be erected at Port Kembla in order to allow the development of a hot and cold tinplate strip mill for Australian Iron & Steel, Ltd.

ELECTRIFIED FARMS. — The Victorian Commission reports that electrified farms served total 11,680, a record increase for the past year of 1,471. Over the last ten years the Commission's consumers outside the metropolitan area have doubled, and electrified farms increased fourfold.

SYDNEY PLANT SHORTAGE.—"Black-outs" in the Sydney area may continue for yet another two years. Plant ordered some years ago is still awaited, and whereas in 1939 the Sydney County Council sold electricity to 256,000 consumers, who used 633,000,000 kWh, it is estimated that the 289,000 existing consumers will consume some 1,185,000,000 kWh. Although demand has almost doubled since 1939, it is not beyond the designed capacity of the plant at Bunnerong and Pyrmont, but the coal supply problem is most acute. As from 1st March Sydney light and power charges rose by an average of 7 per cent. Operating costs have risen steeply, and this year's coal will cost £267,000 more to purchase and transport, fuel oil will cost £80,000 more, and wages will be up £450,000.

Canada.—ONTARIO EXPANSION SCHEME.—The Great Lakes Power Company is to embark on a $2,000,000 expansion programme. A 13,000-h.p. extension to the power plant at Michipicoten River, 90 miles north of the Soo, is to be constructed and storage dams on the Montreal River and Lake Manitowic on the Michipicoten River will be completed. The company will also extend rural power lines throughout the district.

Southern Rhodesia.—DEMONSTRATION FARM.—The Electricity Supply Commission has announced its intention of starting a 2,000-acre farm at Umniati to test and demonstrate all new electrical farm equipment. It hopes to complete the electrification of the more densely settled rural areas by 1951.

TRANSPORT

Newcastle-on-Tyne. — NEW TROLLEY-BUS ROUTES.—The City Council is to convert the Jesmond Road and Benton Road tram routes to trolley-buses. The Benton Road route will be linked up with the Great North Road. The changeover, it is expected, will be carried out this year.

South Africa.—TROLLEY-BUS ASSEMBLY.—The *South African Electrical Review* reports that the first trolley-bus to be assembled in the Union was recently completed at the B.M.S. works at Jupiter and delivered to the Johannesburg Transport Department. Altogether fifteen vehicles are to be delivered to the City Council by the end of June, the chassis being imported from England.

NEW BOOKS

Rubber Technology. Physics Textbook.

Modern Rubber Chemistry. By H. Barron. (Second Edition.) Pp. 502; figs. 140; index. Hutchinson's Scientific and Technical Publications, 47, Princes Gate, London, S.W.7. Price 36s.

This is a valuable addition to those too few educational books on this subject that have been published in this country. The title, unfortunately, is somewhat misleading and more correctly could have been " Modern Rubber Technology."

The elementary theory of the chemistry of rubber is given, but it does not occupy a large part of the book. An attempt has been made in these sections, however, to discuss high polymeric chemistry in simple terms, although many important details are omitted.

Many modern technological processes are discussed, including the direct use of latex, the anode process, the use of pellet rubber, the electron microscope, high-frequency heating and the Mooney plastometer. Unfortunately, they are not treated in sufficient detail and the reader just becomes interested when the text finishes. This applies in general to the whole book and, although most of the processes for the manufacture of rubber and its products are mentioned, they are not considered in sufficient detail to be a practical guide. As an example, the various factors influencing work on mills is mentioned, but details are not given as to how allowances should be made for these factors.

On the chemical side, the sections on accelerators and vulcanization theory are quite good, although the modern theory of the oxidation of rubber and the important work on the swelling of rubber in solvents is hardly touched. Again, little emphasis is laid on the modern theory of testing. The different methods are described, but are not compared. Except in the case of abrasion resistance, the importance of rigidly controlling every factor in the test operation sequence is not sufficiently stressed.

The book is well produced and written, and should be an excellent introduction to the new comer and elementary student.—W.S.P.

Introduction to Modern Physics. By F. K. Richtmyer and E. H. Kennard (Fourth Edition). Pp. 759; figs. 241; index. McGraw-Hill Publishing Co., Ltd., Aldwych House, Aldwych, London, W.C.2. Price 36s.

Changes have been made in this edition, which is primarily intended for advanced students or graduates, to record the significant advances of the last five years and reflect the readjustment of perspective on the physical scene. Apart from numerous alterations of wording in the earlier chapters, there are extensive additions to Chap. XI on cosmic rays. The treatment of many electron atoms in Chap. VIII has been rewritten, the main theme now proceeding in terms of quantum states rather than wave functions, which are meaningless to the student who is not studying mathematical theory. Reference is made in Chap. XI to the Van de Graff electrostatic generator, and equipment constructed in the U.S.A. is described, but the author apparently seems to be unaware of the striking progress recently made in the design of this apparatus in England.—A.R.P.

Advanced Industrial First-Aid, 1947. By R. A. Trevethick, M.B., Ch.B. Pp. 63. H. Garnett & Co., Ltd., 42, Effingham Street, Rotherham, Yorks. Price 3s.

This pocket-size booklet is intended for those who have some knowledge of the subject and was compiled specially for use in the works of the United Steel Companies, Ltd. Its author is the resident medical officer at the Steel, Peech & Tozer branch of the organization. His recommendations are up to date. Electric shock is mentioned only as needing artificial respiration; the latter is not described, but the author's preference is for the Schafer method in the absence of Eve's apparatus.—W.O.F.

Electronic Circuits and Tubes. By the War Training Staff of the Cruft Laboratory, Harvard University. Pp. 948; figs. and index. McGraw-Hill Book Co., Ltd., Aldwych House, Aldwych, London, W.C.2. Price 45s. in the U.K.

This book, written by a team responsible during the war for the training of Army and Navy officers in the U.S.A., comprises the lecture material used for pre-radar courses. It is concerned almost entirely with the theory and application of ordinary thermionic valves and the circuits, mainly radio, in which they are operated. The treatment of the subject is very thorough.

The first nine chapters are devoted to the properties of circuit elements singly and in combination. Resonance, coupled circuits, matching and filters are discussed in detail. Chapter X on thermionic emission is brief, indicative of the emphasis placed on the circuit rather than the physical aspects of the subject. Chapter XI on triodes, tetrodes and pentodes, and the part of Chapter XIV on power valves are notable for detailed discussions of their characteristic curves. Cathode-ray tubes and rectifiers receive less exhaustive treatment. Circuits for amplification, modulation and detection as well as rectifiers and oscillators are treated with the same detail as the valves themselves, and there is a long chapter on radio receivers.

The writing is clear and the analysis is managed with the minimum of mathematics. There

seem to be few mistakes or misprints, and adequate references and bibliography are given.—V.J.F.

Books Received

Alternating Currents Simplified (2nd Edition). By G. W. Stubbings, B.Sc., F.Inst.P., A.M.I.E.E. Pp. 217; figs. 92; index. Crosby Lockwood & Son, Ltd., 20, Tudor Street, London, E.C.4. Price 10s. 6d.

Cathode Ray Oscillographs. By J. H. Reyner. Pp. 189; figs. 134; index. (3rd edition). Sir Isaac Pitman & Sons, Ltd, 39, Parker Street, London, W.C.2. Price 8s. 6d.

Questions and Answers on Electric Motors (Third Edition). By E. Molloy. Pp. 120; figs. 105; index. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 5s.

Cathode Ray Oscillograph in Industry (3rd Edition revised). By W. Wilson. Pp. 252; figs. 197; index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 18s.

Radar Beacons. By A. Roberts. Pp. 489; figs. and index. McGraw-Hill Publishing Co., Ltd., Aldwych House, Aldwych, London, W.C.2. Price 36s. in U.K.

On-Load Voltage Regulators

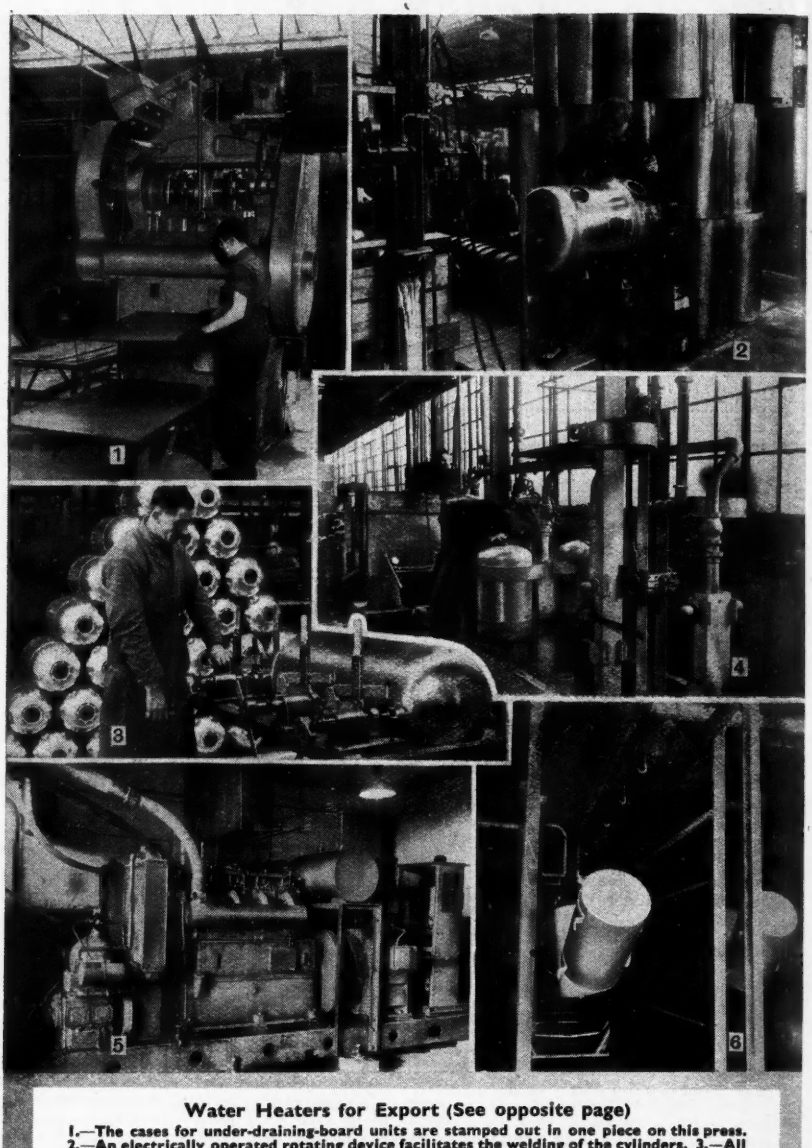
Production at a South-East London Factory

FACILITIES for the manufacture of "Breco" on-load voltage regulators and other types of transformers have been greatly improved by the recent move of Brentford Transformers, Ltd., to a new factory at Kidbrooke, London, S.E.3. This large single-storey building has enabled the company to keep pace with the growing demand from home and export markets for its special products. The factory has the most modern equipment (including special plant designed by its own engineers), which enables the company to build all types of transformers with ratings of up to 1,000 kVA.

Assembly bay for the on-load voltage regulators and other special transformers (Right) Tank fitting shop

Stepless on-load voltage regulators are finding ever-increasing applications in both industrial and electric power distribution. They are being used successfully to provide a variable voltage from a constant supply, which is required for the control of the output of electric furnaces, variable-speed motors, electro-plating plants, testing apparatus, X-ray equipments and a.c. to d.c. rectifier plants. Another application is the provision of a constant voltage from a variable supply, in connection with the demand for feeder pillar and pole-mounting automatic regulators.

Adopted instead of on-load tap changing gear, the regulators improve the control of power distribution systems. The special features of the design provide stepless voltage regulation under load conditions without interruption of the current; high efficiency; no phase displacement; safety and simplicity of operation; elimination of switches, moving coils and moving cores; and a robust construction. Over 50 per cent of production is now for export.



Water Heaters for Export (See opposite page)

1.—The cases for under-draining-board units are stamped out in one piece on this press. 2.—An electrically operated rotating device facilitates the welding of the cylinders. 3.—All water containers are tested to at least 100 lb per sq in. and in some cases to 180 lb per sq in. 4.—This special jig is used to retap the threads on the pipe connections of the cylinders after tinning. 5.—Two 55-kW stand-by diesel generating sets. 6.—The time for paint drying has been reduced from 24 hours to 45 minutes by means of this infra-red plant

Production for Export—V

Special Water Heaters

THE efficiency and convenience of electricity for water heating are already appreciated in every country where power is available for domestic purposes. The potential world market is very large indeed, but under present conditions water heaters are probably the most difficult of the commoner electrical appliances to sell abroad.

Aidas Electric, Ltd., however, has built up a substantial export trade in various types of electric water heaters largely because it is producing models specially designed for export. This does not mean that, in order to compete in price with foreign manufacturers, apparatus is being manufactured of somewhat lower quality than that for the home market. On the contrary, the special high-quality models referred to would find a ready sale in this country if they could be made available.

The special designs have been developed largely as a result of a personal investigation into local market requirements by the company's managing director, Mr. L. P. Häussauer, who has in the past few months visited, among other places, South Africa, Rhodesia, Portugal, Egypt and Canada. Generally no radical departures from standard patterns have been involved and the modifications made centre largely on appearance, which seems to have a far greater " pull " abroad than in this country. For instance, the addition of narrow bands of blue is one of the devices adopted to give " eye-appeal " to the two most popular export models, a flat-type 3-gal. (13·6-litre) thermal-storage type unit and a 30-gal. (136-litre) dual-purpose heater which is identical in general design to the 20-gal. (91-litre) " UDB " (under-draining-board) unit now becoming so popular in this country. It has a 500-W element constantly in circuit at the top to give 7-8 gal. of water at 160 deg F (32-36 litres at 71 deg C) immediately with a separate bank of 2,500-W manually controlled elements at the bottom for switching on when the whole 30-gal. capacity of hot water is required.

Completed water heaters ready for packing are shown in our title picture. All the units in the background with lines round them are for export

Local Market Requirements Investigated

To meet the growing export demand there has been a complete overhaul of production methods at the company's factory at Northolt with the result that output has been doubled. The output per man-hour is now well above the pre-war figure, and as a result the incentive bonuses shared by all workers have also doubled.

Everything possible is now done mechanically; measuring by hand and individual fitting have been largely eliminated. Among the most interesting of the special production devices now being employed are a press for cutting out " UDB " cases in one operation; electrically operated rotating stands for holding cylinders when welding; a jig enabling the threads of all water inlets to be cut simultaneously; various pressure testing appliances—all cylinders are tested to at least 100 lb per sq in. (7 kg per cm^2) and sometimes to 180 lb per sq in. (12·6 kg per cm^2); and a shaker for use in cork filling. Operating conditions in the paint spraying department have been much improved by the installation of fluorescent lighting. The installation of an infra-red drying plant has speeded up paint drying from 24 hr to 45 min and makes it possible on occasions to make and dispatch orders within one day, which would previously have taken at least three days.

To guard against possible stoppages through load-shedding two 55-kW Brush diesel generating sets have been installed. These are of sufficient capacity to take the full day load.

Production has also been simplified by concentrating on only about one-quarter of the number of models made before the war, and it is worth mentioning that the increased output has been achieved despite the vast amount of extra work involved in having to use poorer quality steel.

The company is now exporting well over one-third of its output, and in the face of import restrictions and control of sterling in many countries has shown an increase every quarter since the drive for exports began.

United States Exports

Increase of 85 per cent in 1947

THE following statement based on official returns issued in Washington, gives the values of the exports from the United States in 1947 of a number of electrical products with notes of the principal destinations and the increase or decrease compared with 1946. The grand total of all electrical exports in 1947 was $563 million compared with $304 million in 1946. Included are Lend Lease, U.N.R.R.A. and Greek-Turkish Aid shipments.

Class and Destination	1947 $ (000)	Inc. or dec. on 1946
Generators, d.c.	2,515	+ 1,455
To Canada	406	+ 76
„ *Mexico*	169	+ 5
„ *Brazil*	145	− 36
„ *South Africa*	8	− 53
„ *Argentina*	405	+ 387
„ *Spain*	199	+ 199
„ *India*	108	+ 98
Generators, a.c.	3,231	+ 1,570
To Mexico	283	+ 49
„ *Colombia*	206	+ 53
„ *Brazil*	309	− 31
„ *U.S.S.R.*	451	+ 255
„ *Canada*	426	+ 269
„ *Spain*	209	+ 201
Steam turbo-generator sets, 500 kW and over	10,194	− 11,096
To Mexico	2,377	+ 1,949
„ *Argentina*	1,612	+ 1,612
„ *U.S.S.R.*	1,673	− 12,675
„ *Venezuela*	372	− 33
„ *Brazil*	319	+ 290
„ *Ceylon*	400	+ 400
„ *China*	1,428	− 2,845
Self-contained lighting sets	8,681	+ 2,328
To Canada	1,145	− 409
„ *Brazil*	927	+ 275
„ *Mexico*	936	− 755
„ *Venezuela*	862	+ 313
Flashlight batteries	5,715	+ 881
To China	537	− 570
„ *Venezuela*	433	− 39
„ *Colombia*	120	− 410
„ *Brazil*	554	+ 188
Diesel electric generating sets	25,818	+ 10,918
To Mexico	2,860	+ 1,633
„ *Venezuela*	1,263	+ 530
„ *Brazil*	2,152	+ 1,091
„ *Argentina*	4,951	+ 3,821
„ *Britain*	1,368	+ 1,298
„ *U.S.S.R.*	1,606	− 2,413
„ *India*	1,232	+ 1,186
„ *China*	1,344	+ 413
Power transformers, over 500 kVA	7,106	+ 4,436
To Mexico	1,144	+ 934
„ *Brazil*	1,127	+ 505
„ *U.S.S.R.*	1,742	+ 1,742
„ *New Zealand*	712	+ 712
Distribution transformers, not over 500 kVA	3,565	+ 1,719
To Colombia	236	+ 93
„ *Mexico*	1,118	+ 470
„ *Venezuela*	158	+ 50
„ *Chile*	86	− 39
„ *Brazil*	236	+ 157
„ *U.S.S.R.*	264	+ 196
Mercury power rectifiers	1,010	+ 603
To U.S.S.R.	138	+ 80
„ *Brazil*	455	+ 190
„ *Holland*	218	+ 218
Circuit breakers and switches over 10A	9,452	+ 5,408
To Canada	2,064	+ 888
„ *Brazil*	606	+ 232
„ *Mexico*	1,165	+ 666
„ *Venezuela*	375	+ 155
„ *U.S.S.R.*	803	+ 345

Class and Destination	1947 $ (000)	Inc. or dec. on 1946
Convertors	2,972	+ 1,490
To Brazil	205	− 52
„ *China*	108	− 42
„ *U.S.S.R.*	607	+ 387
„ *Canada*	465	+ 18
Battery chargers, non-rotating	1,471	+ 219
To Canada	200	− 218
„ *Brazil*	142	+ 36
„ *South Africa*	213	+ 97
Motors, stationary, 1–200 h.p.	13,479	+ 4,105
To Canada	1,386	+ 668
„ *Mexico*	2,180	+ 808
„ *Brazil*	1,464	+ 644
„ *U.S.S.R.*	788	− 787
Mining and industrial locomotives	3,726	− 1,735
To Canada	392	− 8
„ *Brazil*	984	− 650
„ *U.S.S.R.*	1,199	− 1,238
Refrigerators, household	39,628	+ 27,989
To Canada	4,094	+ 2,933
„ *Mexico*	2,643	+ 1,112
„ *Brazil*	6,632	+ 5,027
„ *South Africa*	4,365	+ 3,216
Lamps, small, filament	4,913	+ 2,658
To Canada	854	+ 488
„ *Argentina*	717	+ 399
„ *India*	244	+ 108
„ *Australia*	238	+ 122
Lamps, large, filament	4,501	+ 514
To Colombia	238	− 65
„ *South Africa*	274	+ 101
„ *Canada*	271	− 58
„ *Venezuela*	260	+ 128
„ *Chile*	165	− 55
„ *Brazil*	200	− 81
„ *Argentina*	347	− 152
Lamps, fluorescent tube	2,416	+ 1,330
To Canada	187	+ 51
„ *Brazil*	165	+ 136
„ *Argentina*	508	+ 139
„ *Belgium*	196	+ 194
„ *China*	182	+ 126
„ *S. Africa*	179	+ 137
Electric washing machines	10,984	+ 8,932
To Canada	5,132	+ 4,264
„ *South Africa*	589	+ 531
„ *Mexico*	1,352	+ 697
Electric flat irons	2,928	+ 1,596
To Canada	362	+ 147
„ *Mexico*	578	+ 320
„ *South Africa*	63	− 517
„ *Colombia*	195	+ 87
„ *Venezuela*	217	+ 136
Heating and cooking devices	6,143	+ 1,835
To Canada	2,165	+ 629
„ *Mexico*	592	+ 88
„ *China*	106	− 245
„ *South Africa*	389	+ 42
„ *Belgium*	127	+ 104
Insulating material	2,997	+ 1,048
To Canada	1,128	+ 175
„ *Brazil*	175	+ 71
„ *Argentina*	137	+ 64
Wiring supplies and line material	5,109	+ 2,627
To Canada	1,208	+ 624
„ *Mexico*	414	+ 161
„ *Brazil*	410	+ 293
„ *Venezuela*	330	+ 72

CONTRACT INFORMATION

Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—9th July. Brisbane City Council. Three 11-kV, 800-A, three-phase metal-clad switchboards.*

Benfleet.—5th June. U.D.C. Vertical-spindle centrifugal pump, complete with motor and wiring, at the Council's Rushbottom Lane sewage pumping station. Surveyor, Council Offices, Thundersley, Essex.

Birkenhead.—12th June. Corporation. Installation of electric lift at Municipal Hospital. (See this issue.)

Dundee.—26th May. North of Scotland Hydro-Electric Board (Dundee Area). Multicore high- and low-voltage paper-insulated cables. (14th May.)

India.—Office of the High Commissioner. Supply of 3,890 domestic type refrigerators. Forms of tender from the Director General, India Store Department, 32-44, Edgware Road, London, W.2. (7th May.)

Herefordshire.—County Council. Engineering, electric lighting and power installation, etc., at new primary school, Hunderton, Hereford. (14th May.)

Isle of Ely.—19th May. County Council. Installation of electric lighting and power, Bowthorpe Hall, Wisbech. County architect, March.

Lincolnshire.—4th June. County Council. Electrical works at Stoke Rochford Hall, Kesteven Training College. (See this issue.)

Portuguese East Africa.—June 15th. Portuguese Directorate-General of Colonial Development. Two turbo-alternaters, two boilers, switchgear, etc., for new power station at Lourenço Marques.*

Spain.—SEVILLE.—Compania Sevillana de Electricidad. 10,000-kW turbine, 18,200-kVA generator, 18,200-kVA transformer, switches and measuring instruments for a hydro-electric scheme. Manufacturers should communicate direct with the Seville firm and notify the Export Promotion Department of the Board of Trade (reference 33566/48) of any action taken.

South Africa.—BLOEMFONTEIN.—1st July. City Electricity Department. Overhead line material.*

Uruguay.—MONTEVIDEO.—9th July. Usinas. Electricás y Telephonos des Estado. Supply of 62 transformers ranging from 600 kVA to 5,000 kVA.*

* Specifications may be inspected at the Export Promotion Department, Thames House North, Millbank, S.W.1.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Adlington.—Secondary school; G. Noel Hill, Lancashire county architect, County Offices, Preston.

Belford (Northumberland).—Houses (30) for the R.D.C.; T. C. Arrandale, surveyor.

Bristol. — Reconstruction of Little Theatre, Colston Street; city architect, Eagle House, Colston Avenue.

Canterbury.—New Simon Langton girls' school on Old Dover Road site; L. H. Wilson, city architect, Municipal Buildings.

Carlisle.—New block at Mental Hospital, Garlands, for the Westmorland and Cumberland Joint Committee; J. M. Sheppard & Partners, architects, 38, Bedford Place, London, W.C.1.

Chelmsford.—Physiotherapy block at Chelmsford and Essex Hospital, London Road; O'Neill & Fordham, architects, 65, Springfield Road.

Coventry. — Occupational centre for the mentally deficient at Stoke, Coventry; D. E. E. Gibson, city architect, 1a, Warwick Row.

Crook (Co. Durham).—Houses (46) for U.D.C.; J. Twiname, builder, Cockermouth.

Dartford.—Houses (32) and flats (56), Temple Hill estate; T. Armstrong, town clerk.

Devon.—Canteen kitchen and dining rooms at three schools; H. V. de Courcy Hague, county architect, 97, Heavitree Road, Exeter.

Durham.—Hospital and convalescent home for Durham County Mental Hospital (£290,000); county architect, Court Lane.

Houses (36), Sunderland Road estate; W. J. Greene, city engineer, Town Hall.

Ellesmere Port.—Houses (30), Stanney estate; P. J. Hodges, clerk, U.D.C. Offices.

Falkirk.—New high school at Bantaskine, for Stirlingshire E.C.; county architect, Viewforth, Stirling.

Finchley.—Houses (60), Elmhurst estate; borough engineer and surveyor, 294-296, Regent's Park Road, N.3.

Glasgow.—Engineering workshops for Roscoe Engineering Co., Ltd.; Gratton & McLean, architects, 113, West Regent Street.

Golborne.—County college for Lancashire E.C.; G. Noel Hill, county architect, County Offices, Preston.

Hartlepool.—Houses (85), Middle Warren site; R. H. Snowball, borough engineer.

Helston.—Extensions and alterations to R.N. Air Station, Culdross; W. G. Northcott & Co., Ltd., builders, 38, High Street, Exeter.

Ilford.—Rebuilding factory premises; Ilford, Ltd., Roden Street.

Houses (62), Maypole estate; L. E. J. Reynolds, borough engineer, Town Hall.

Jarrow.—Houses (44), Bilton Hall site; H. W. T. Perkins, borough engineer, Town Hall.

Kirkburton.—Factory, near Burton Dean Quarry, for Moxon & Sons, Ltd., worsted manufacturers; J. Radcliffe & Sons, builders, Huddersfield.

Lanarkshire.—Secondary school at Rutherglen (£65,000); county architect, County Council Offices, Glasgow.

Leicester.—Secondary schools, Gwendolen Road and Hamelin Road; city architect, Town Hall.

Liverpool.—Flats (48), in three blocks, Brook House estate, and ten flats and shops, Cantril Farm estate; director of housing, Blackburn Chambers, Dale Street, Kingsway.

Lowestoft.—Infants' school, St. Margaret's Road (£75,000), for Suffolk E.C.; county architect, Burlington Road, Ipswich.

Luton.—Houses (26); H. C. Jones, Ltd., builders, 189, High Town Road.

Houses (24), Eaton Valley Road; Hunting Aviation Management, Ltd., The Airport.

Primary school, Leagrave estate; borough engineer, Town Hall.

Manchester. — Public Health Laboratory, Monsall Hospital; Medical Research Council, 38, Old Queen Street, London, S.W.1.

Engineering department and physics laboratory, College of Technology, for E.C.; J. Dickinson & Co. (Builders), Ltd., Fairclough Street, Bolton.

Additions to Loreto Grammar School for Girls, Moss Lane, for Rev. Mother Superior; Reynolds & Scott, architects, 9, Albert Square.

Secondary school at Baguley Hall for E.C. (£147,175); G. & J. Seddon, Ltd., builders, Manchester Road West, Little Hulton.

Markinch.—Infants' school; county architect, County Offices, Inverness.

Midhurst.—Houses (100), for R.D.C.; T. Greenfield, architect, Council Offices, North Street.

Morley.—Dwellings (56), Albert Road and Garden House Lane estates, Tingley; H. Brook, architect, Queen Street.

Newcastle-on-Tyne.—Additions to the Royal Victoria Infirmary; J. & W. Lowry, builders, Corporation Street.

Norwich.—Houses (82), Earlham (West) estate; junior school, North Earlham; city architect, Municipal Offices.

Nuneaton.—Houses (100), Caldwell estate; borough surveyor, Town Hall.

Oxford.—Primary school, Barton, for E.C.; Hinkins & Frewin, Ltd., builders, Canal Street.

Plymouth.—Houses (24), Pennycross estate; school, Barne Barton; E. G. Catchpole, city architect, Weston Lodge, Seymour Road.

Redditch.—County school for Worcestershire E.C. (£49,290); L. C. Lomas, county architect, 60, The Tything, Worcester.

Rochdale.—Extensions to Infirmary; G. P. Fairhurst, architect, 55, Brown Street, Manchester, 2.

Sarn.—County school at Capel Salem for Caernarvonshire E.C.; W. Lloyd Jones, county architect, County Offices, Caernarvon.

Sheffield.—Printing works, Portobello Street and Holland Street; Greenup & Thompson, Ltd., Welling Street.

Southend-on-Sea.—Proposed new town hall (£1,500,000); E. Vincent Harris, architect, 19, West Eaton Place, London, S.W.1.

Southgate.—Flats (36), Bramley Road; J. T. W. Peat, borough engineer, Southgate Town Hall, Palmers Green, N.13.

Southport.—Permanent houses (50), Rufford Road, Crossens; R. E. Perrins, town clerk, Town Hall.

South Shields.—Houses (226), two nursery schools and four shops in Lizard Lane; borough engineer.

Sparsholt (Hants).—Extensions to Sparsholt Farm Institute (£73,500), for C.C.; county architect, The Castle, Winchester.

Sprowston (Norfolk).—Infants' school; F. G. Limmer, county education architect, Stracey Road, Norwich.

Surrey.—Schools, Kingston Vale (Robin Hood), Malden (Green Lane), Mitcham (Sherwood) and Guildford (Park Barn); J. Harrison, county architect, County Hall, Kingston-on-Thames.

Swansea.—Houses (220), Gendros and Penllan estates, for T.C.; G. Wimpey & Co., Ltd., builders, Oxford Road, Denham, Middlesex.

Swindon.—County grammar school, Headlands Avenue; F. I. Bowden, county architect, County Hall, Trowbridge.

West Bromwich.—Houses (56), Tanhouse estate, for T.C.; Eadie & Co., Ltd., builders, Waterloo Road, Wolverhampton.

West Ham.—Transport depot, Riles Road, Plaistow (£109,000); borough engineer, Town Hall, E.15.

Wheatley.—Girls' grammar school, Holton Park; G. R. Hutton, county architect, 3, Becket Street, Oxford.

Whitehaven.—County school, Cleator Moor, for Cumberland E.C.; J. H. Haughan, county architect, 4, Alfred Street North, Carlisle.

Wolverhampton. — Houses Deans Wood Road (50), and Tettenhall (350); W. M. Law, borough engineer, Town Hall.